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The Mining Magazine

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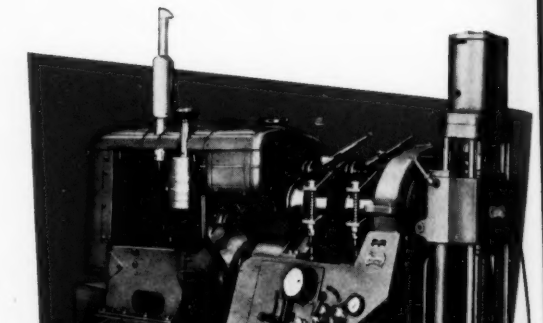

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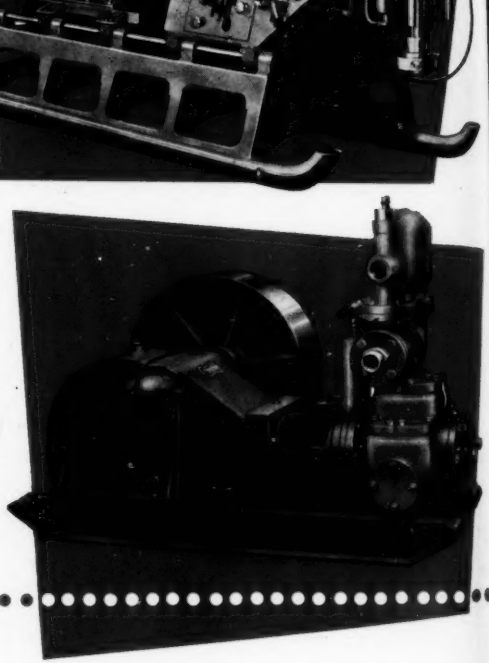

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EDITORIAL

IN the Birthday Honours List among names that will be noticed by mining men are those of Dr. R. B. McConnell, Director of Geological Surveys, British Guiana, who is appointed C.B.E., Dr. W. Pulfrey, Commissioner (Mines and Geology), Kenya, Mr. F. W. Roe, deputy director Overseas Geological Surveys, and Mr. G. E. Howling, formerly principal of the Mineral Resources Division, Overseas Geological Surveys, each of whom receives the O.B.E. It is a pleasure also to record that Mr. H. E. Fern, chairman of Mining Publications, Ltd., has been advanced to C.B.E.

ARRANGEMENTS have now been completed for the ninth International Congress of Photogrammetry. It is to be held in London from September 5 to 22 and is under the patronage of H.R.H. The Prince Philip, Duke of Edinburgh. It is being organized with the support of the Government by a Congress Board representing the Royal Institution of Chartered Surveyors, the Photogrammetric Society, and the British National Committee for Photogrammetry. At a Press conference last month it was explained that air survey, as one is apt to think of it, can be applied in two ways. First, as simple aerial photography, but, secondly, for the preparation of maps and plans made by measurements on aerial photographs, or "photogrammetry." Much attention is now paid to the second application. The stereoscopic model, oriented and set to a correct scale (either by means of ground points of known position, located on the photograph, or by using entirely airborne aids such as radar altimeters and aircraft tilt measuring instruments) is an immensely more convenient subject to measure than the earth's surface at natural scale. However, the first application, generally well known and understood, is used widely as an inexpensive, rapidly produced, and incomparably detailed field map. It can also be used to photograph special details of technical interest which can be interpreted from it—such as, geological structures, vegetation patterns to serve as indicators to underlying soils, or the tell-tale rippling of the surface which is warning of soil creep and erosion in tropical lands. There are, however, many non-topographic applications of photogrammetry. These include the measurement of objects and processes which do not permit of direct measurement, or the direct measurement of which is complicated and time-consuming. Thus it covers objects which are of complex structure and to which access is difficult and also objects whose shape and size would be altered by the very process of direct measurement.

LAST month delegates from the copper and copper alloy fabricating industries in western European countries were present when the general assembly of the International Wrought Non-Ferrous Metals Council met in Burgenstock, Switzerland. The specialist committees of the council have had, it seems, an active year. The Substitution and Development Committee, for example, has kept a close watch on cases of replacement of copper by other materials, while the Costing Committee has issued a "Guide to the Principles of Costing in the European Non-Ferrous Metals Industry" in English, French, and German, which should be of value to all. The Technical Committee has compiled accident statistics and made suggestions for accident prevention, while also giving attention to the problem of how to secure supplies of unwrought metal in a form suitable for mechanical handling; the response from the suppliers of zinc slabs, it is stated, has been particularly satisfactory. The Statistical Committee has recently compiled statistics of the end-uses for copper and copper alloy semi-finished products in 1959 and is also taking steps to compile monthly statistics of the actual consumption of refined copper by members. These should be a great advance on the quarterly statistics (usually of apparent consumption) which are at present available and they should enable both the fabricators and the suppliers of their raw materials to plan more effectively in the short period. The next meeting of the Council in 1961 is to be in France.

South Africa Looks to the Future

Presenting his retiring address to the 70th annual general meeting of the Transvaal and Orange Free State Chamber of Mines last month Dr. W. J. Busschau said that he had not only to comment on the affairs of the mining industry during 1959 but also on its achievements in the past 50 years—one of great economic progress in which the mining companies forming the Chamber had played their full part. Since 1910 the industry had made a full contribution to the establishment and growth of the economy of the Union, happy in the possession of an export article which all the world wanted. Gold, said Dr. Busschau, as the final means of settling international indebtedness could enter through doors which import controls closed against other commodities. In 1910 the exports of South African produce totalled £52,000,000, of which gold accounted for £32,000,000 and the products of diamond and other mining for £11,000,000. To-day the gold-mining industry supported a large superstructure in which other industries had been able to develop until they not only supplied a large proportion of the needs of the Union's increased population but were also able to export. South Africa's exports in 1959 totalled £632,000,000, of which the products of the gold-mining industry, including uranium oxide, accounted for £292,000,000. Diamonds and other mining contributed £73,000,000. Manufacturing industry, in its infancy in 1910, exported goods worth £96,000,000 in 1959. Exports of raw agricultural produce amounted to £107,000,000 and the manufactures of agricultural products to £64,000,000.

In the course of his address Dr. Busschau, having analysed gold-mining operations in the various fields, extending from Kinross in the east to the Odendaalsrus-Virginia sector in the deep south, mentioned in passing how important it was for the gold-mining industry, and for South Africa, constantly to explore and develop new ground to replace that consumed by mines as they exhaust the ore within their boundaries. Mining ground is being used up at a rate greater than ever before. Further expansion of output, and later the maintenance of that output, will depend on the emergence of new producers and the authorities concerned should be fully aware that they are failing in their responsibilities unless they create a favourable setting for exploration for gold and its exploitation. The risk factor in opening a new mine remains high, the retiring president said, capital expenditure in bringing a new mine to production being greater than ever. Thereafter, when a new mine has successfully reached the production stage, the company is still subjected to a system of discriminatory taxation, which laps as dangerously as any other currents in an uneasy world at the foundations of investment confidence both within the Union and abroad. It is clearly in the interests of the State, as well as of the industry itself, Dr. Busschau suggested, that capital should be found for the establishment of new mines. Much of that capital would have to be found in the money markets of the world and if that were not forthcoming the rate of the country's future economic growth would be retarded considerably. The discriminatory taxation of the gold-mining industry remained unjustifiable and unwise, he thought, not only from the viewpoint of the investor but also from that of the State (and both within and without the Union investment opinion on that point, as well as on the point of share-market fluctuations and its related mechanisms, had become very much stiffened in recent months). The Government had been urged by the gold-mining industry to remove discrimination among the various tax-paying companies, even if only gradually, so that in due course such discrimination would disappear. In referring to the question of the gold price Dr. Busschau commented that the United States no longer enjoyed that freedom of action in monetary matters which it could exercise some years ago. That country's monetary authorities would appear now to be faced with a dilemma, between easing credit to avoid a recession and at the same time thereby accelerating a loss of gold through holders of short-term dollar stocks converting into other currencies. The gold-mining industry felt that an adjustment of the gold price was still inevitable, but " we are told that preoccupation with political matters, such as the forthcoming presidential election and the increase in tension following the failure at the summit are likely to delay the monetary adjustment."

The views of the Chamber were recently fully reflected in the joint address of the country's leading institutions on the native unrest in the country. Dr. Busschau rounded off his annual statement with the comment that the attainment of providing security for

everyone while bringing to all the peoples of the Union the tangible and intangible benefits of " Western civilization " was not an easy one. There might be disagreement on methods ; there was little lack of concord on the aim. It was clear, he thought, that the process of civilized advance with security could best continue in an atmosphere of economic expansion.

The retiring president concluded by saying that those in the mining industry knew that they had made a substantial contribution through their economic activity in the first 50 years of Union and they hoped to make their full contribution in the years ahead. The industry recognized that recent events, within and without the Union, showed that the problems were more difficult than they might previously have appeared, but they hoped and believed that they could and would be solved through co-operation and goodwill. Given timely and effective action to deal with the problems there was no reason, Dr. Busschau thought, to doubt that the mining industry could give an even more impressive performance in the future than it had done in the past.

Overseas Geological Surveys

In 1947 the central organization of the Overseas Geological Surveys was founded by the Secretary of State for the Colonies as a practical contribution to the development of the geology and mineral resources of the United Kingdom's overseas territories. Initially housed in South Kensington in offices in the Imperial Institute building it eventually outstripped its accommodation and the Colonial Office has now provided modern headquarters with adequate facilities in Gray's Inn Road. These were formally opened by H.R.H. The Duke of Edinburgh on July 1.

The functions of Overseas Geological Surveys have been briefly set out as follows : (*a*) To provide a central advisory bureau on all matters relating to the geology and mineral resources of overseas territories ; (*b*) to provide specialist facilities and mobile teams of experts for photogeological, geophysical, geochemical, and other modern techniques in the field, and (*c*) to provide a central intelligence and laboratory research service directed primarily to the promotion of the industrial development and utilization of mineral raw materials. The new headquarters, with a staff of qualified scientists, provides ample facilities for this work.

At the official opening this month H.R.H. The Duke of Edinburgh was introduced by the Rt. Hon. Iain Macleod, Secretary of State for the Colonies. In the course of his remarks the Duke made appreciative reference to the " patient and unspectacular work by the Mineral Resources Department of the Imperial Institute in the early years of the century." Thereafter, he said, in the ten years between 1948 and 1958 the volume of mineral exports from the Colonial territories had nearly doubled and the value of minerals they produced was running at the rate of about £250,000,000 annually. Nevertheless, he suggested, the surface had so far been only scratched and there were many years of useful work ahead for the Directorate both in the Colonial territories and in those underdeveloped countries which might like to take advantage of the practical help which the Directorate could offer.

In his reply Dr. S. H. Shaw, now Director of Overseas Geological Surveys, referred to the advantages of being able to carry out scientific work in new premises specially designed and laid out for the purpose, but emphasized that the work of the Directorate was basically the discovery, assessment, and development of the mineral resources of the overseas territories by the application of geological science. Mining was one of the basic essentials of man's existence, Dr. Shaw said, perhaps even the most important. Ore-bodies were, however, Dr. Shaw said, the result of the extraordinary or unusual processes of nature. The interrelationship of geology, mining, mineral resources, and economics was thus a complicated one and they were in a sense no strangers to natural uncertainties. When to natural uncertainties they had added man-made ones they still dared to hope that the fundamental nature of their work would be understood. He was glad that the Secretary of State was optimistic as to the future of specialist services and that the matters he mentioned were to be given their proper importance. Dr. Shaw will not, of course, be the only one relieved. All mining men look forward to the increasing help the new Surveys headquarters can supply and many no doubt appreciated the opportunity of seeing something of the work in progress which was afforded on the opening day.

MONTHLY REVIEW

Introduction.—The course of events in the Congo must naturally arouse anxiety in the neighbouring territories, perhaps particularly in the Central African Federation. So far, however, stability seems assured and the Northern Rhodesian copper industry has not been affected.

Transvaal.—The gold return figures for the Rand and O.F.S. mines for May show a production of 1,765,880 oz., making with 37,897 oz. from outside mines a total of 1,803,777 oz. for the month, a new record. The number of natives at work in the gold mines at the end of May was 383,212, as compared with 385,841 at April 30 last.

The table below shows dividends declared by the Rand mining companies for the past half-year. Figures for the three preceding half-years are added for comparison, the denominations of shares being £1 unless otherwise stated.

	2nd half, 1958	1st half, 1959	2nd half, 1959	1st half, 1960
	s. d.	s. d.	s. d.	s. d.
Blyvooruitzicht (2s. 6d.)	1 0	1 1	1 2	1 3
Brakpan (5s.)*	0 6	0 4½	0 6	0 4½
Buffelsfontein (10s.)	1 6	1 6	1 9	1 10½
City Deep	0 7½	0 7½	0 7½	0 7½
Consolidated Main Reef	1 6	1 6	1 3	1 6
Consolidated Murchison (5s.)	5 3	2 9	5 6	3 6
Crown Mines (10s.)	1 9	1 9	2 0	2 0
Daggafontein (5s.)	2 6	2 3	2 3	2 0
Dominion Reefs (5s.)	1 6	1 6	1 6	1 6
Doornfontein (10s.)	1 6	1 6	1 6	1 6
Durban R'd'poort D'p (10s.)	1 6	1 6	1 6	1 6
East Champ d'Or (2s. 6d.)	0 3	0 3	0 3	0 3
East Daggafontein (10s.)	0 7½	0 7½	0 7½	0 7½
East Geduld (4s.)	1 11	1 9	1 11	1 8
East Rand Prop. (10s.)	2 0	1 9	1 9	1 9
Eastern Rand Ext. (5s.)	1 0	0 9	1 0	0 9
Eastern Transvaal Consol. (5s.)	0 1½	0 3	0 1½	0 3
Geduld Prop.	6 3	4 9	5 0	3 4
Grootvlei Prop. (5s.)	1 3	1 1	1 5	1 1
Hartebeestfontein (10s.)	3 6	3 6	3 0	3 0
Libanon (10s.)	0 3½	0 3½	0 3½	0 4½
Luipaards Vlei (2s.)	1 0	1 0	1 0	1 0
Marievale Consolidated (10s.)	1 5	1 4	1 7	1 6
Middle Wits (2s.6d.)	0 6	0 7½	0 7½	0 7½
Modderfontein B. (3d.)	1 0	—	0 6	—
Modderfontein East	0 6	0 6	1 0	0 6
New Klerksdorp (5s.)	0 9	1 0	1 0	1 3
New Pioneer Central Rand (5s.)	—	2 9	1 3	1 9
Rand Leases (3d.)*	—	—	1 0	—
Randfontein	2 3	1 9	2 3	1 3
Rietfontein Cons. (3d.) *	—	—	0 8	0 6
Simmer and Jack (1s. 6d.)	—	—	—	—
South African Land (3s. 6d.)	1 6	1 3	0 6	0 6
South Roodepoort M.R. (10s.)	1 1½	1 1½	1 1½	1 1½
Southern Van Ryn	0 7	—	0 7	—
Springs Mines (5d.)*	0 4½	—	0 6	—
Stilfontein (5s.)	1 10½	1 10½	1 7½	1 6
Sub Nigel (3d.)*	—	—	1 3	1 3
Vaal Reefs (5s.)	2 0	1 6	2 0	1 6
Venterspost (10s.)	0 10½	0 10½	0 10½	1 0
Village Main Reef (1s. 3d.)	—	—	—	—
Vlakfontein (10s.)	1 0	0 11	1 0	0 11
Vogelstruisbult (3d.)*	1 0	—	0 10	0 8
West Driefontein (10s.)	4 0	4 3	4 9	2 7½
West Rand, Ord. (10s.)	2 3	2 0	2 3	2 0
Western Reefs (5s.)	1 3	1 3	1 3	1 3
Witwatersrand Nigel (2s. 6d.)	—	0 1½	—	0 1½

* Capital Repayment.

Shareholders of CENTRAL SOUTH AFRICAN LANDS AND MINES were informed on June 21 that AFRIKANDER LEASE, LTD., had had its uranium sales quota increased from 88·9 tons to 117·77 tons per year retrospective to July 1, 1958. The company's actual sales quota for the years 1960 to 1964, subject to annual review by the Atomic Energy Board and the Combined Development Agency, will thus be at the rate of 126·47 tons per annum, made up of its basic quota *plus* an additional 8·7 tons as an adjustment of the shortfall for the period July 1, 1958, to December 31, 1959. It was a condition of the grant of an increased quota, it is stated, that the company should relinquish its claim to the quota of ELLATON GOLD MINING which it was to have taken over when that company ceases production and in respect of which a royalty and also amortization payments would have been payable.

At the annual meeting of RAND MINES, LTD., held recently in Johannesburg, shareholders were told that during 1959 there was a marked increase in expenditure on prospecting and exploration. Large areas were examined and drilled for gold but unfortunately with negative results. Work was done in the Ventersdorp and Delmas districts in the Transvaal while in the Orange Free State an area across the Vaal River from the Klerksdorp field was drilled, together with two separate blocks of farms in the Brandfort district. These areas have all been abandoned. Efforts were not confined to precious metals and during the course of the year the company purchased the entire issued capital of an operating company called LESLIE MINERALS (PROPRIETARY), LTD., which was mining for iron ore in the Rustenburg district of the Transvaal. Subsequent operations revealed that the deposits were of limited extent and that further exploitation would be unprofitable. Active prospecting for gold and base minerals in South Africa is continuing and investigations in the field of chemical and metallurgical engineering are being undertaken. In addition, exploration was started and is continuing in South-West Africa and Southern Rhodesia, mainly for copper.

Diamonds.—In the six months to June 30 last, DE BEERS CONSOLIDATED MINES announces, the sales of diamonds through the Central Selling Organization totalled £43,728,714, of which gem stones realized £31,240,138.

It is announced that the DIAMOND MINING AND UTILITY CO. (SWA), LTD., has ceded to DE BEERS CONSOLIDATED MINES prospecting and mining rights for diamonds in an extensive coastal area between Walvis Bay and Luderitz. The agreement provides that Diamond Mining will receive from De Beers a loan which will be used to finance the former's operations in the southern section retained and that the former company will also receive 20% of the net profit to be earned by De Beers from exploiting the more extensive northern section, over which it has now secured rights.

Southern Rhodesia.—The consolidated accounts of the UNION AND RHODESIAN MINING AND FINANCE COMPANY for 1959 show an available total of £290,160. Of this amount £97,100 has been transferred to reserve and £75,000 taken for dividends equal to 3d. a share. After £3,987 required for other items a balance of £114,073 is carried forward.

Northern Rhodesia.—With the recent dividend notice shareholders of NCHANGA CONSOLIDATED COPPER MINES were informed that the accounts for the year ended March 31 last show a net operating profit of £13,643,764, which compares with £4,704,535 for the previous year.

Ghana.—The operations of BREMANG GOLD DREDGING in 1959 resulted in a profit of £216,111, the accounts showing £305,755 available. Of this amount a dividend equal to 15% requires £47,930, while £141,226 has been set aside for dredge transfer expenditure and £85,000 transferred to debenture redemption reserve, leaving £31,599 to be carried forward. In the year 9,351,500 cu. yd. of ground was treated and 67,493 oz. of bullion recovered.

Nigeria.—The report of GOLD AND BASE METALS OF NIGERIA, LTD., for 1959 shows a profit of £57,021 and £82,919 available, of which a dividend equal to 7½% requires £35,372. In the year 541 tons of tin concentrates and 70 tons of columbite were produced. At the end of the year the company's proved reserves were estimated to be 4,511 tons of tin concentrates and 334 tons of columbite in 12,570,150 cu. yd. of ground. The report states that in the year experiments were undertaken in the Delimi area with a view to improving mineral recovery by the installation of a cyclone and jig in place of sluice-boxes. Results were most satisfactory; not only in increased mineral recovery but also in effecting an immediate appreciable saving in direct costs. It has therefore been decided to install similar plants in the other working areas.

It is reported from Jos that negotiations are in hand with a view to the establishment of a smelting plant and the formation of a company in Nigeria to be called the NIGERIAN EMBEL TIN SMELTING CO., LTD.

Angola.—The profit of the ANGOLA DIAMOND COMPANY for 1959 amounted to Esc. 106,105,900, to which has to be added the balance brought forward from the previous year of Esc. 20,908,152; after deducting the amount of Esc. 34,600,000 for the interim dividend paid on November 16, 1959, there remains a balance of Esc. 92,414,052. The report states that diamond production in 1959 attained the highest figure recorded in the company's history; 1,002,284·08 carats were recovered from mining operations and 13,403·82 carats were collected during prospecting. Of the total 60·13% was in gem stones and 39·87% in industrial diamonds. The programme of exploration for 1960 provides for the treatment of 2,166,300 cu. m. of gravel to produce 830,325 carats of diamonds, but the indications are that these figures will be exceeded. Prospecting on the River Saga, tributary of the Luembe, has proceeded with very satisfactory results. Geological studies have led to the discovery of a new Kimberlite formation in a small tributary to the south of the River Goege in the Luachimo basin and in 1960 two more have been revealed in other parts of the same area. Amongst these discoveries, now numbering 22, those on two small tributaries of the River Goege offer special interest in view of the large number of diamonds of good quality which were collected there.

Australia.—The report of the SONS OF GWALIA, LTD., for 1959 shows a profit of £24,647, which reduces the debit balance brought in to £54,662. In the year the mill treated 153,138 tons of ore for a recovery of 33,547 oz. of gold. At December 31 last the ore reserves were estimated as 237,100 tons averaging 5·06 dwt.

Ora Banda, 40 miles north-west of Kalgoorlie, has been known as a gold-mining centre since about 1892. For some time the ASSOCIATED NORTHERN (ORA BANDA) and the Victorious and Gimlet mines were well known. The place has been an active centre for a small group of local prospectors and their latest success has been 300 tons for 100 oz. secured within a mile of the Battery. They have called the lease the "Sleeping

Beauty"—a wide lode outcropping, yet passed over for all these years; 500 tons of similar ore is already "in sight."

LAKE VIEW AND STAR, LTD., employees received an unexpected addition to normal pay on May 13—a £5 bonus to each of the 1,045 employees. This was a pleasing gesture by the company to mark the 50th anniversary of the merger of the old Lake View Consols with the Annans Star Company (to make Lake View and Star, Ltd., which was registered on May 2, 1910). Other properties have been added in the years since 1910 to make the company the largest property and biggest Golden Mile producer.

Malaya.—It was announced last month that, following negotiations with SOUTHERN TRONOH TIN DREDGING for a merger of interests with TRONOH MINES, the directors of Tronoh propose to make, with the approval of the directors of Southern Tronoh, an offer to purchase the whole of the issued capital of Southern Tronoh not already owned by Tronoh on the basis of one fully-paid share of 5s. in Tronoh for every two shares of 5s. each in Southern Tronoh, *plus* 2s. 6d. in cash for each share acquired. The offer is to be conditional upon acceptance by the holders of not less than 90% of the issued shares in Southern Tronoh. The report of Southern Tronoh for 1959 shows a profit of £38,287, as compared with £43,587 for the previous year. After charging £16,771 for taxation and crediting surplus on realization of investments, £15,255, there remains a balance of £36,771 to which must be added the 1958 balance of £67,387, making a total credit of £104,158. Abortive prospecting expenditure amounting to £371 has been written off. Dividends equal to 9d. a share require £18,375. Both dredges remained shut down, on a care and maintenance basis, the whole of the company's Quota Rights being produced by Tronoh Mines.

A statement issued by AYER HITAM TIN DREDGING last month states that the board has decided that now that the new No. 2 dredge has reached its full digging depth and is operating profitably the time is appropriate "to bring the issued capital of the company more into line with the capital invested in the business by making an issue of shares by capitalization of reserves." This is to take the form of an issue of four new fully-paid shares of 5s. each for each share of 5s. held. After the scrip issue the issued capital of the company will be £1,525,000. It is intended shortly to close down No. 1 dredge for conversion to electric drive, re-plating the pontoon, and the installation of jigs and during the conversion it is hoped that the profits from No. 2 dredge will be sufficient to enable a reasonable return to shareholders on the increased capital.

The accounts of GOPENG CONSOLIDATED for the year to September 30 last show a profit of £81,952 and £134,459 available, of which dividends equal to 10½d. a share require £45,729. In the year 852,200 cu. yd. of ground was treated and 391 tons of tin ore recovered.

Thailand.—The report of the SIAMESE TIN SYNDICATE for 1959 shows a group profit of £148,143 and a net return of £42,772, which, with the sum brought in, makes £54,546 available, of which £16,733 is required for a dividend. In the year 1,633 tons of tin ore was produced, ore reserves being calculated as 92,137,000 cu. yd. of dredgeable ground carrying 20,225 tons of tin concentrates and 13,071,000 cu. yd. of gravel-pumping reserves carrying 3,569 tons.

India.—At the annual meeting of the CENTRAL PROVINCES MANGANESE ORE COMPANY held in London last month shareholders were informed that during 1959 diamond drilling continued at New Tirodi and at West Ramrama. Normal exploration work at the Gumgaon and Ukwa mines indicated that the deposits at these two mines continue laterally, the ore in both cases being of good quality. This work is to be continued and be supplemented at Gumgaon by diamond drilling exploration. The opencast at Beldongri, which has not been worked for some years, was unwatered successfully during the year and arrangements are now in hand to lower inclines and develop this pit, which contains ore of high quality.

Burma.—In the nine months to March 31 last the BURMA CORPORATION (1951), LTD., extracted 94,072 tons of ore and produced 12,814 tons of refined lead, 13,565 tons of zinc concentrates, and 1,148,764 oz. of silver. In addition 277 tons of copper matte, 241 tons of antimonial lead, and 242 tons of nickel speiss were produced. The operating profit for the period is given as £331,875.

The accounts of the ANGLO-BURMA TIN COMPANY for the year to September 30 last show a profit of £5,696, of which a dividend equal to 3d. a share requires £2,654. In the year 304 tons of tin concentrates was produced.

Colombia.—In the three months to March 31 last PATO CONSOLIDATED GOLD DREDGING

treated 5,947,000 cu. yd. of ground and recovered 26,706 oz. of gold. The profit for the period is given as $170,000. During 1959 20,579,000 cu. yd. of gravel were dredged for an average recovery of 16·7 cents per cu. yd., which compares with 22,100,000 cu. yd. of an average value of 18·8 cents for the previous year. Recovery of 102,978 fine oz. gold is a decrease of 19,683 oz. from the 1958 recovery of 122,661 oz. The reduction in volume and gold recovered was largely due to No. 4 dredge being out of production for 7½ months.

Jamaica.—It is reported that the ALUMINUM CO. OF AMERICA has acquired mining rights on 30,000 acres of bauxite-bearing lands in Clarendon. A construction programme involving the creation of a port, harbour, and transport facilities is to be started at the end of this year. It is also stated that ALUMINA JAMAICA, LTD., recently passed the 2,000,000-ton mark in its total production of alumina.

Canada.—It was announced on June 27 that the STANLEIGH URANIUM MINING CORPORATION and PRESTON EAST DOME MINES have entered into an agreement for amalgamation. The amalgamated company, which will be known as PRESTON MINES, is to assume all liabilities of both the companies. Its authorized capital will consist of 5,000,000 4% cumulative redeemable preference shares of the par value of 50 cents each and 10,000,000 common shares without par value. The RIO TINTO MINING CO. OF CANADA is to undertake that it will, for a period of 90 days following the date when the amalgamation becomes effective, purchase all preference shares of the amalgamated company tendered to it within that period at the price of 50 cents cash per share. The proposed amalgamation will involve shutdown of the Stanleigh mine.

The closing down of operations at the Beaverlodge uranium mine of RIX ATHABASCA URANIUM MINES was announced earlier this month. The property was kept in operation throughout the past winter despite the scarcity of economic ore. Extensive exploration has failed to reveal further ore on the property and the present workings have become uneconomic to operate. The officials of the company are actively engaged, it is stated, in examining other mining properties with a view to the profitable use of the company's resources and personnel.

Israel.—In the 1959–60 fiscal year the TIMNA COPPER WORKS exported its entire output of 5,400 tons of cement copper. It is reported that indications of mineral primary copper recently discovered in the vicinity of Timna and a new appraisal of the known ore deposits there have led to a doubling of estimates of the field's production potential. Earlier there were 17,000,000 tons to 18,000,000 tons of ore averaging 1·4% copper.

DIVIDENDS DECLARED

*Interim. †Final.

(Less Tax unless otherwise stated)

African and European Investment Co.—Pref. 3%, payable Aug. 15.

†**Anglo-Burma Tin Co.**—3d., payable July 27.

†**Anglo-Transvaal Consolidated Investment Co.**—Ord. and A Ord., 3s.

***Apex Mines.**—1s. 9d., payable Aug. 5.

***Apex (Trinidad) Oilfields.**—6d., free of tax, payable July 22.

Bancroft Mines.—Pref. 6½%, payable June 30.

***Bralorne Pioneer Mines.**—10 cents, payable July 29.

†**Gold and Base Metal Mines of Nigeria.**—2½d., payable July 29.

***Malayan Tin Dredging.**—7½d., payable Aug. 23.

***Middle Witwatersrand (Western Areas).**—7½d.

†**Nchanga Consolidated Copper Mines.**—8s. 9·6d., payable Aug. 25.

***Phoenix Colliery.**—1s., payable Aug. 4.

***Rand Mines.**—3s., payable Aug. 4.

***Rooiberg Minerals Development.**—1s. 6d., payable Aug. 5.

***Southern Malayan Tin Dredging.**—7½d., payable Aug. 23.

†**Southern Tronoh Tin Dredging.**—3d., payable July 14.

Tanganyika Concessions.—Pref. 4%, payable July 29.

†**Tanjong Tin Dredging.**—3d., payable Aug. 20.

***Transvaal Consolidated Land and Exploration.**—2s. 3d., payable Aug. 4.

***Tweefontein United Collieries.**—4½d., payable Aug. 2.

***Vereeniging Estates.**—3s., payable Aug. 18.

***Welgedacht Exploration Co.**—3d., payable Aug. 4.

***West Rand Consolidated.**—Def., 113s. 4d.

***Western Mining Corporation.**—6d. Aust., payable Aug. 12.

METAL PRICES

July 8.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	186	0	0
Antimony (Eng. 99%)	190	0	0
Chromium (98%–99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	30	5	0
Silver		6	7½
Gold	12	9	10¾
Wolfram (U.K.)		—	
(World)	7	19	0

Tin, Copper, Lead, Zinc } See Table, p. 48.

Two Notes on Mineral Processing

K. K. Majumdar [1]

The dressing of wet-ground mica and an improved flotation cell

(1) Preparation of Wet-Ground Mica

Wet-ground mica, mainly used for the paint industry, is nowadays made principally in the United States or Great Britain. In America it is prepared from waste mica by grinding it wet in a chaser mill lined with wood and using wooden rollers (1).[2]

A special steam-water grinding process, with or without chemical treatment, has been developed in Great Britain (2), while according to a French Patent (3) mica is first heated to 800° C. and then dropped into a saturated solution of sodium carbonate, the excess liquid drained off, and the solids again dropped into a 5% hydrochloric acid solution and vigorously stirred. In another French Patent (4) it is suggested that the mica should be partly dehydrated at 700° to 900° C. and then plunged into water and agitated under reduced pressure. Again, according to an Indian Patent No. 31510 (1945), (5) mica is suspended in water in the presence of inorganic sodium salts (sodium metabisulphite, sodium borate, sodium sulphite, etc.) and the pulp vigorously agitated. A U.S. Patent (6) states that mica containing 17% to 35% by weight of water is ground under mechanical pressure of 3–11 lb./sq. in. gauge for 0·5 min. to 3 min., while it is also ground in the United States in the micronizer.

An attempt was made by the author to grind mica in common equipment which needed practically no attention and the product remained free from contaminants. A porcelain-lined ball-mill (batch type) using pebbles was used and the product was excellent (7). Cleaned scrap mica free from adhering impurities (cleaned by jigging) was fed into a ball-mill with sufficient water to make a thick pulp. The use of a batch-type porcelain-lined ball-mill has the following advantages :—

(1) Since the mill is run covered chances of contamination during grinding from other sources are negligible.

(2) Since the mill is porcelain lined the product is not contaminated with iron stain from the shell of the mill.

(3) Similarly by using porcelain balls or pebbles the product is free from stain.

(4) Since the mill is covered during operation there is no loss of water by evaporation so that there is no need to add water from time to time to prevent " burning " of the mica.

References

(1) U.S. Tariff Commission Report No. 130.
(2) Johnstone, S. J. " Minerals for the Chemical and Allied Industries."
(3) French Patent No. 34307 (1947), Soc. Quartz et Silice, Paris.
(4) French Patent No. 45154 (1952), Samica, Paris.
(5) Indian Patent No. 31510 (1945), Roy, R. C., Patna.
(6) U.S. Patent No. 2,547,336 (1951), McDaniel, Wm. T., Jr., and LeGrand, J. R.
(7) Indian Patent No. 57840 (1956).

(2) Improved Air-Lift Flotation Cell

A new type of flotation cell combining the advantages of the air-lift and mat types of flotation cell but free from the defects of such cells is described in what follows.

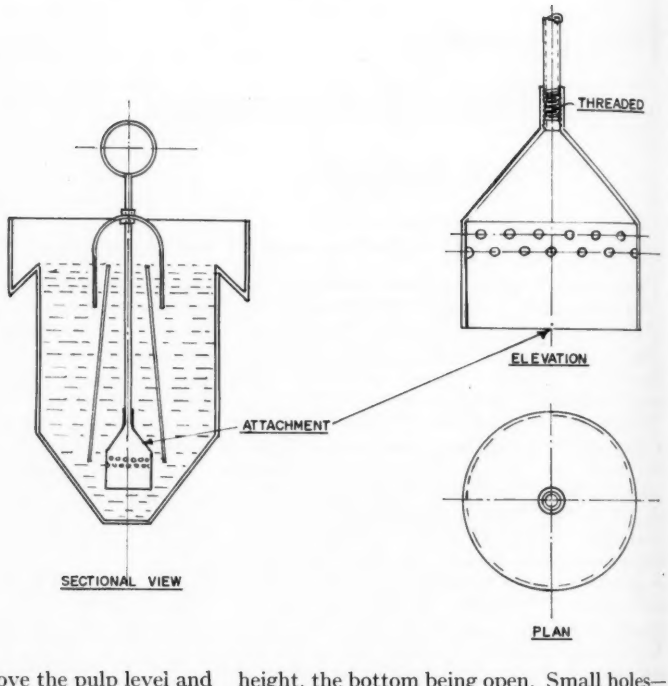
Essentially the cell is of the air-lift type, but the lower end of the down pipe through which compressed air is admitted is fitted with an attachment. The purpose of this is to break up the air bubbles into a number of smaller bubbles so that their carrying power for adhered mineral particles is increased.

In the conventional air-lift cell the rising bubbles of air are rather large, since they are released from the end of the pipe, the diameter of which may vary from ½ in. to 1¼ in. The rising bubbles are made to strike

[1] Ore Dressing Section, Metallurgy Division, Government of India Atomic Energy Division, Trombay.

[2] References are given at the end of the note.

Air-Lift Type Flotation Cell.



a baffle plate placed above the pulp level and in doing so the bubbles are broken and dispersed. Since the chance of contact between the bubble and a mineral particle is slight in this type of cell a large amount of air is wasted.

In the mat type of cell small air bubbles are released in the pulp by forcing air to pass through a mat or a porous surface. The difficulty with this type of cell, however, is that the porous surface gets clogged very easily, especially when the operation is stopped and the suspended mineral particles are given a chance to settle on the porous surface. If the attachment to be described here is fitted, however, the air bubbles generated are fairly small in size and the porous surface never has a chance to become clogged. Even if the holes are clogged the plant will not go out of operation since air can still escape from the down pipes as fairly small bubbles.

The attachment fitted consists of an inverted cone with a collar fitted on the apex which may be threaded for fixing to the bottom end of the down pipe. Otherwise fixing of the attachment can be carried out by any other simple means. The other end of the cone is extended as a cylinder short in height, the bottom being open. Small holes—say, $\frac{1}{8}$ in. in diameter—are drilled on the vertical wall of the cylinder near the top; they may be in one or more horizontal rows. Below the holes there must be sufficient height in the cylinder so that air bubbles may not escape through the bottom opening during normal working conditions. If by chance the holes are clogged air bubbles will have a chance to escape around the periphery of the cylindrical wall and in doing so still get dispersed. The attachment is thus maintained in order. There is, of course, a gap between the bottom surface of the attachment and the bottom of the cell. Such attachments can be fitted into a row of down pipes in an air-lift type of flotation cell.[1]

If necessary deflectors can be fitted to the down pipes above pulp level but it is not essential. Since there are no moving parts cells of this type will give trouble-free and efficient service over a long period. Perforations can also be made on the cone near its lower end. Since the surface is sloping the chance of deposition of minerals on this surface is less; hence the holes are not likely to be clogged.

[1] Indian Patent No. 60727, dated 7th June, 1957.

Modern Trends in Plant and Mining Instrumentation

A review appropriate to a recent London exhibition.

Andrew L. Forrester

(*Concluded from the June issue, p. 352*)

Alarm Instruments and Devices

The use of alarms and of alarm instruments and devices in the mining industry is sufficiently well known to need only brief treatment. The trend to install warning instruments is justified as plant becomes more automated and elaborate. Many instrument makers and most electrical manufacturers produce one or the other item which fall into this category. A new micro-adjusted snap-action limit switch is available from the motor and control gear division of Associated Electrical Industries, Ltd., for which these design features are claimed : Operating lever secure in any position over 360° with micrometer adjustment ; accurate repetitive tripping ; one switch can operate two independent circuits ; oil-proof and weather-proof enclosure ; three alternative methods of mounting ; stay-put or self-reset operation in either direction arranged on site without extra materials or special tools ; mechanical " knock-off " safety device ; renewable silver-to-silver double-break contacts and self-lubricating bearings. The company's electronic apparatus division has developed protective instruments and apparatus for warning of crane approach, alarms using light-sensitive photo-electric elements, and safe-starting systems for conveyors.

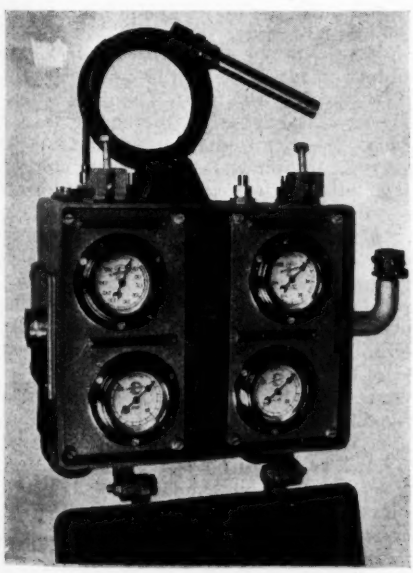


Fig. 7.

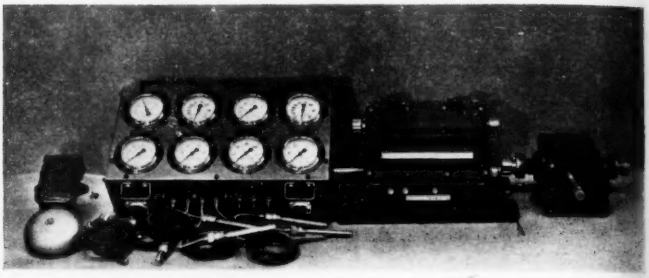
A problem which has occupied the minds of switch designers and manufacturers for some time is a reliable means for linking mechanical movement with associated electrical or electronic control gear, alarm circuits, and protective devices. The new G.E.C. Type SA auxiliary switch is claimed to have solved this problem. Unit elements allow to build-up from one to 12 circuits. The use of silver-plated contacts with easy adjustments, the possibility to pre-set individual contact assemblies in any one of 21 positions, and other design features make this switch very suitable for use in mining.

Several developments have taken place in the use of dip electrodes for measuring liquid levels or heights of solid material in bunkers, etc. Fig. 9 shows an application of the what is called the " No-Flote " method for measuring and indicating (or recording) the height of material in a bunker by Evershed and Vignoles, Ltd. Change of electrical capacitance is utilized for similar instrumentation.

Photo-Electric Equipment

A close-up view of a dual-level photo-electric hopper level control equipment made by Radiovisor Parent, Ltd., is shown in Fig. 10. For its operation this is based on the interruption of a light beam between a sender (incorporating a source of light) and a receiving instrument. This contains a light-sensitive photocell and relay which either interrupts or provides electric current if no light falls on its sensitive element.

Fig. 8.



Another example of photo-electric equipment is that which has come into use since the introduction of smokeless zones in this country and made by Londex, Ltd. (Fig. 11). A light beam projected across a chimney stack from a projector reacts on a photo-electric receiver. A lens directs the light on to a photo-sensitive device, which in turn sounds an alarm if smoke develops over an allowable density in the chimney.

Timing devices represent an important aspect of control, the intervals in question ranging from seconds or minutes to hours and even days. Several specialist firms manufacture a variety of process timers for the purpose of switching electrical apparatus " on " or " off " after a preset period of time has elapsed. In addition to providing time control some types can be connected to an audible (horn) or visible (lamp) warning signal. Both spring and motor-operated devices are available. Fig. 12 shows the process timer made by Venner Time Switches, Ltd., and Fig. 13 the wiring diagram and dimensions.

Fig. 9.

Magnetic Flowmeter

Metering of the flow of liquids or of liquid transported solids, especially where they have abrasive characteristics, is performed by a new type of inductive instrument marketed in this country by Alto Instruments (Great Britain), Ltd., in which the principle used is one of the most interesting of recent developments in flow metering. No orifice or venturi tube is used and the meter has no moving parts. Electro-magnetic induction gives rise to an electric potential when a conductive liquid flows through the non-conducting meter body, this potential being proportional to the flow. The detector consists of a stainless-steel measuring tube to which the electro-magnet is fixed. An electronic amplifier and an indicator are used, but a chart recorder or an automatic flow recorder can be actuated.

S.M.R.E. Methanometer.—This instrument is one of the many developed by the Safety in Mines Research Establishment and is sufficiently accurate for general testing purposes, can be operated by unskilled personnel, and is light, compact, and reliable. It can be produced at a reasonable price and requires maintenance only at long intervals (Fig. 14).

The design of the instrument is described in S.M.R.E. Research Report No. 162. As in some other methanometers the gas is estimated by the change in electrical resistance of a detecting element when methane is oxidized on the element's surface. The detecting element forms one arm of a Wheatstone bridge; the other arm is formed by a

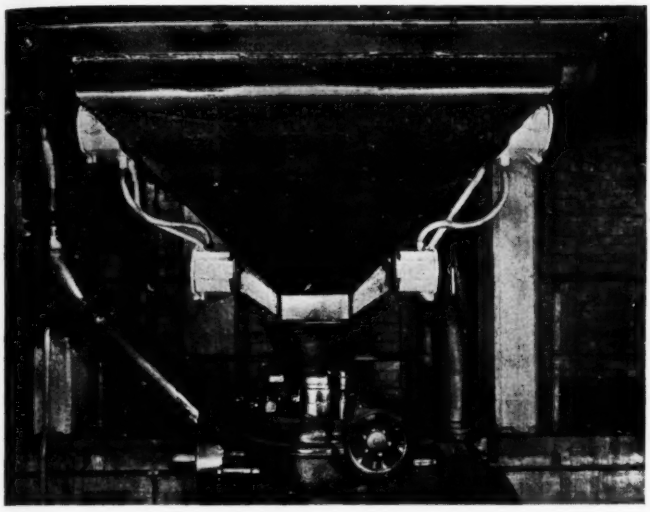


Fig. 10.

" compensating " element, on which methane is not oxidized, but which is equally affected by variables, such as atmospheric pressure, which affect the detecting element.

In most methanometers of this type the elements are coils of platinum wire ; metal evaporates from the surface of the elements at the temperatures necessary to oxidize methane and the instrument requires provision for constant re-adjustment. An important innovation in the S.M.R.E. Methanometer is that the platinum wire is embedded in a pellet of alumina ; in the case of the detecting element the alumina is coated with a palladium catalyst. Since the platinum is not exposed to the methane, and the catalyst causes the methane to oxidize at comparatively low temperatures, there is very little evaporation of the metal and the elements remain stable for a long period. This has made it possible to simplify the design of the instrument, since no provision need be made for frequent adjustment. This type of element is sufficiently stable to allow the bridge circuit to be embedded in resin, which is a considerable advantage as regards safety, robustness, and cheapness.

The methanometer is very simple to operate : gas is drawn into the instrument by a rubber hand pump, a flexible disc on the front of the instrument is pressed, and a steady reading (on a scale calibrated in per

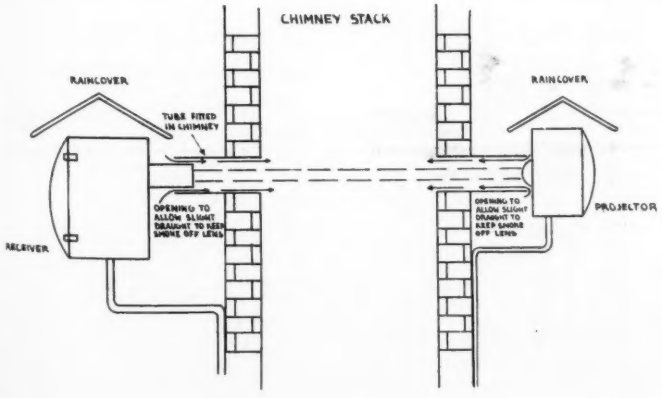


Fig. 11.

Fig. 12.

cent. methane) is given within a few seconds. The methanometer can be used with an extension tube for taking samples from such places as roadway roofs. Modified forms of the instrument can be used for the estimation of other inflammable gases.

Load Cells for Weighing

Electric load cells are used to-day for various purposes, such as weighing the contents of storage bins, or to measure weights applied at one or more points on a weighbridge. The sensing or detecting element may be some form of strain gauge, or it may be an electro-magnetic transducer like that shown in Fig. 15 made by Salford Electrical Instruments, Ltd., This is also capable of measuring tension or thrust up to 300 lb. and uses a hydraulic capsule, which is essentially a shallow cylinder having its piston or platen bonded to its walls by a flexible rubber joint. Under the platen is a liquid and its pressure is transmitted to the transducer, the latter converting pressure into a measurable electrical signal.

Remote Automatic Pump Control

Automatic control and supervisory systems for pumps used in mine drainage have been developed such as the Elliott-Shotter system which provides measurement of water level, transmission to the control point and observation panel, automatic control of the pump motor starter, indication and recording of water level, and alarm annunciation and fault protection. From several schemes a standard pumping set situated close to an open underground sump with remote supervision has been worked out. The equipment is illustrated in Fig. 16.

As has been mentioned pneumatic telemetering is used in mining plants where distances are comparatively short and also where for safety reasons electrical transmission is less suitable. The Commander class of instruments developed by George Kent, Ltd., for telemetering are available in both pneumatic and electrically operated types. The transmitter operates at the measuring point and a wide range of single- and multi-point receivers is made for remote indication, recording, and integration incorporating the latest ideas for rate of flow measurement.

A range of electronic and nucleonic instruments is made by Ericsson Telephones, Ltd., in their instrument division at Nottingham. Selected as of interest is their load cell shown in Fig. 17, which is the Nobel type developed jointly by I.C.I. and E.T.L. to

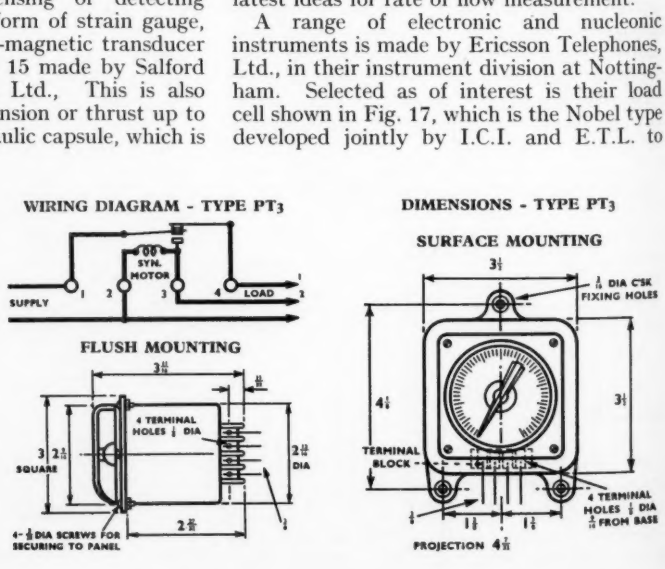


Fig. 13.

Fig. 14.

give extreme stability and is therefore eminently suitable for use in locations where the system zero cannot easily be checked. An accuracy of $\pm 0{\cdot}25\%$ is possible in weighing installations using this type of load cell and is maintained over long periods. The characteristics of the cell are unaffected by corrosive atmospheres and in many cases the initial cost of an installation using these cells is lower than that of the equivalent mechanical system.

Where the weights of several bodies are required, each can be supported on a set of load cells and one indicating instrument, such as the E.T.L. digital strainmeter type 307A or digital strainmeter type 170A, can be used to check the weight of any of the bodies. In this way costs can be reduced because a single indicating instrument replaces the many required in mechanical systems. Remote indication facilities can be provided and the outputs of several cells can be added or averaged as required.

The cells are designed to withstand considerable overload and the effects of non-axial loading are minimized because the load cell housing is constructed to carry side loads comparable with the maximum rated load of the cell. Six standard types of cell covering weights up to 100,000 lb. are available.

Static Switching

Although development of contact switches has reached a high degree of reliability and their time of life has been greatly extended, certain elaborate uses of switching demand contactless elements. A variety of reliable automatic sequence control systems can now be made using contactless proximity switches, power magnetic amplifiers, etc. in place of conventional relays and switches. As an example, Bruce Peebles and Co., Ltd., have designed systems for use in mining operations where high repetition rates, dusty or damp atmospheres, or other onerous working conditions must be catered for. Signalling facilities can be incorporated and mimic diagrams used, all the electronic equipment being without moving parts. Skip-loading equipment can thus be sequence controlled. The use of proximity switches, whereby a sensing element actuates an electrical signal current without actually coming into contact with a moving part will certainly increase as time goes by, although it may be a long while before contact-making devices such as snap-action switches will be replaced. The mere fact, however, that static switching devices

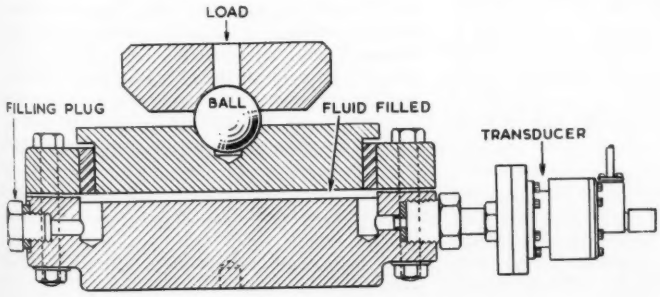


Fig. 15.

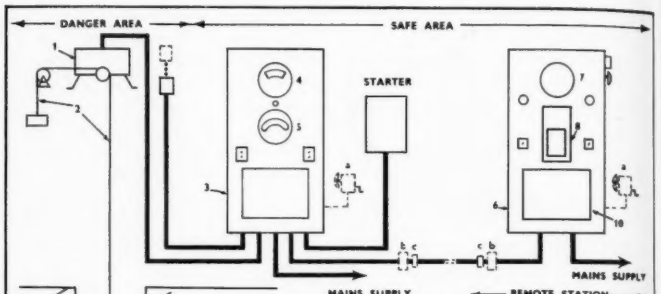


Fig. 16.—Pump Set Control.

(1) Water level transmitter; (2) Float gear; (3) Cubicle; (4) Starter control; (5) Level indicator; (6) Remote cubicle; (7) Level indicator; (8) Level recorder; (10) Trickle charger.

are completely closed and that neither dust, water, or gases can influence their contactless inner working mechanism makes these new switches especially suitable for mining work.

New Magnetic Logical Elements

A great step forward in automatic control schemes was recently made known by the English Electric Co., Ltd., in a range of contactless sensing devices and magnetic logical elements designed to work together. The logical elements take the form of standard packages, providing the "bricks" (basic units) from which many electronic control schemes can be built up. The plug-in element consists of a red nylon frame moulded to form a handle at one end. It has a 32-way plug-and-socket connexion at the other end. Two printed circuit component boards are fitted into each frame. One board takes input circuit components and the other holds magnetic circuit components, with electrical connexions taken to the plug. Each unit is what is called in electronics a complete "logical element." Translated into plain language this means that an assembly of this kind can provide current for adding action ("AND"), can select ("OR"), can prevent current flow ("NOT"), or can delay current flow ("Time Delay"). One of the functions developed in recent years in connexion with computer research and design is what is known as "memory" action, which is stored and can be released at an appropriate moment as and when required. Electronic circuits incorporating such functions are called "logic circuits" and each building block or logic element has as many as possible incorporated.

The circuit details in any given control function are standard for control scheme development. A control scheme can be arranged by the wiring method used leading to the plug sockets. Known as "pick-offs" the sensing devices include magnetic limit switches, proximity limit switches, magnetic push buttons, rotary switches, and contactless tacho-generators. Practical uses for magnetic logical elements and pick-offs are to be found in control gear for all types of material handling operations including conveyor systems.

Molecular Electronic Devices

A major development in electronic instruments and equipment has been achieved recently which is called "molecular electronics" and uses so-called "solid state" sub-miniature elements. Research at the laboratories of the Westinghouse Electric International Co. of America has opened up a very promising new way. Tiny blocks are the latest and most advanced stage in an evolution of electronic circuitry, which started with valve circuits, developed in the last ten years in the transistor, and is to-day on the threshold of further miniaturization and simplification.

Solid-state circuitry derives its name from phenomena occurring between or within the molecules of certain materials. Scientists have "grown" multi-zone crystals, which provide small solid building blocks required in molecular electronic systems. Functional electronic blocks can be assembled from these blocks, each one of which is a complete functioning electronic sub-system. Thus whole circuits such as amplifier or oscillator circuits will be made using one minute piece of solid material. Electronic tubes, resistors, inductors, capacitors, and wiring can be replaced by a block smaller than a sixpenny piece. Such a function block can be designed having instead of 16 components and 18 soldered junctions only one component with two soldered end junctions. Using a vacuum process, metallic vapour from a source filament is deposited on the surface of an alumina or glass substrate which has been masked with the desired pattern of circuit. Noble metals are used or else protective coatings must be applied before the micro-circuit leaves the vacuum chamber.

Westinghouse use a dentritic method to build junctions in adjacent portions of a crystal. The germanium ribbon used grows at a rate of 6 to 12 inches per minute and in a precise direction. The surfaces of the ribbon are optically flat and immediately usable as working surfaces. A new method makes it possible to carry out diffusion, plating, and evaporation processes directly on the crystal as it grows from the furnace melt. Thus solid-state semi-conductor devices can be produced ready for the attachment of leads. A further discovery is a method of growing multi-zoned dentritic crystals directly from a furnace melt. This makes available basic building blocks having at least three layers of molecular active zones and two interfaces.

Practical uses that can be expected include electronic amplifiers, logic elements for computers, logic switches, telemetering units, communication elements, and multi-vibrators. Prototypes have been made of a variable potentiometer—*i.e.*, a unit which generates a signal in proportion to two dependent but otherwise independent signal inputs. Video amplifiers, tuned amplifiers, and audio amplifiers representing the equivalent of several stages of amplification have been developed for low and for high power. Direct-current amplifiers are also available as prototypes—for example, when connected to a solar cell upon which a flashlight shines. Variation of light intensity produces corresponding outputs. In conclusion, it should be stated, however, that the production of semi-conductor devices and molecular electronic function blocks in large series and eventually automatically is a long-term project.

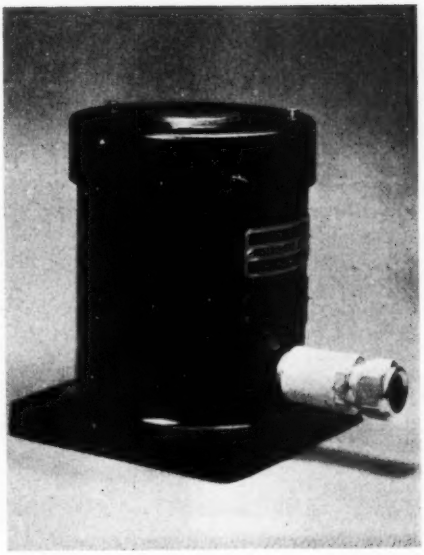


Fig. 17.

This concludes this brief and by necessity incomplete survey of instruments and gadgets of interest to the mining engineer. Acknowledgement is due to many instrument making firms who have placed data and illustrations at the disposal of the writer and which are acknowledged at the appropriate place in his text.

Sierra Leone Diamonds

It is reported from Freetown that there are now 966 alluvial diamond mining licence holders with a labour force of over 13,000 operating in the Sewa River in the Wando and Gorama Mende Chiefdoms of the Kenema District, Sierra Leone. For a distance of about 30 miles from Gendema into Fomaya alluvial activities are at their height, the population being controlled by an Area Superintendent and his assistant, with a number of mine wardens. At Barma, where there are 300 licence-holders, over 4,000

Barrage on the Sewa River.

labourers work daily in the Sewa River and here two major dams totalling 912 ft. in length have been constructed this year to divert the main course of the river. Two embankments forming a large dam across the river were made on co-operative basis, each licence-holder providing equal numbers of labourers and empty palm kernel bags or the equivalent of the bags in money.

Illustrated in the accompanying photographs, the first embankment is 520 ft. long and about 14 ft. wide while the second is 392 ft. long built up to a height of 12 ft. So far this year licence-holders have been able to extract over 500 tons of alluvial diamond-bearing gravel and with more to come. Washing of the gravel for diamonds is to be done when the rains set in.

The Birth of a Scottish Industry

A note on the bicentenary of the establishment of the Carron ironworks.

M. Schofield, M.A., B.Sc., F.R.I.C.

Just 200 years ago the first furnace of the Carron Ironworks was put in blast, a historic event since the Carron works of 1760 was the first true ironworks in Scotland and pioneered the way for works at Clyde, Muirkirk, and elsewhere. Up to 1760 the Scottish iron industry was in the hands of migrant smiths, tinkers, and farriers, with little hope of using the iron ore of the Scottish Carboniferous in quantity. The Carron company was designed to be a Scottish Coalbrookdale, an idea fully justified since the first use of coke in place of charcoal in Scotland was at Carron. The company was founded by William Cadell, Scottish ship-owner and iron dealer, and Samuel Garbett, a Birmingham business man and partner of John Roebuck, the brains behind the venture. The history of chemical industry was changed overnight when Roebuck invented in Birmingham the

lead chamber process for producing sulphuric acid, the key chemical in industry. Roebuck came to Scotland to build a larger vitriol works at Prestonpans and, after taking on other ventures such as a pottery, a salt-works, and a colliery, came to Carron to create an iron industry run on true scientific lines.

The contrast between the Scottish iron trade before Carron and the subsequent rise is an interesting subject. The old iron bloomeries set up near vast resources of wood for charcoal making used bog iron ore, with occasional inclusion of red ore and Clayband ore, these latter being probably imported from England. With timber supplies becoming a serious problem following the ravages of charcoal makers further south it is not surprising to note Highland timber becoming the target of iron smelters. As early as 1607 a rough furnace at Letterewe, in Ross, was an example of the scattered industry, while others on Loch Maree nearby were recorded, although local ore was not used. There are references in history to " a colony and manufactory of Englishmen making iron and casting guns," this the result of a shortage of wood for charcoal in Britain. Before long the Scottish authorities also reacted by passing an act prohibiting the " making of yren from woode."

However, round about 1730 the iron industry was still a spasmodic affair, with small bar iron furnaces appearing in widely scattered places. One at Invergarry used ore imported from Furness, a second at Bunawe, in Argyle, brought in ore from Ulverston, while a third example was a furnace at Inverlacken on Loch Fyne. Red haematites exported to the West of Scotland required expensive transport and thus proved a drawback to Scottish iron developments. For four furnaces at places like Abernethy, Invergarry, and Muirkirm, iron ore imported from Lancashire was used in the 1730's. Before Carron introduced coke smelting to Scotland much charcoal was shipped from Scotland to aggravate the timber problem.

Although in a later period the Scottish iron industry was to suffer decline, until the discovery of Blackband ironstone gave it fresh impetus, the vigorous growth from 1760 to 1800 was due to the lead given by Carron. The region was most favourable to the transforming of a Scottish haphazard trade into the iron industry as we know it to-day. There were coal and limestone mines nearby, water transport from Carron Wharf, wood supplies to tide over the early production until coking became the rule, and ironstone mines to complete the essentials. Most striking, however, were the two leading founders, John Roebuck and Samuel Garbett. Roebuck was the son of a Sheffield cutler who had a prosperous medical practice in Birmingham after graduating in the Edinburgh Medical School. Yet his hobby-horse was chemistry, a very practical chemistry which gave the world not only cheap sulphuric acid on a large scale in place of laboratory-scale production in glass vessels, but also other techniques including scientific method in iron smelting. Although Mushet and Neilson in the Scottish iron industry have been fully publicized, one need but follow the growth of Carron to appreciate the scientific method of Roebuck. Garbett was necessary as the brake when Roebuck's lack of business instinct would have brought bankruptcy earlier than it came to all associated with Roebuck. Garbett was at one time a Birmingham brass worker who came with Roebuck to a Scottish period beginning with the Prestonpans vitriol works. Roebuck, after failing to patent his sulphuric acid process, turned to other Scottish ventures and usually found Garbett ready to join in partnership. He turned to coal mining, leasing the mines of the Duke of Hamilton at Barrowstones, took over some salt-pans there, and then came to Carron to score a triumph—for Scottish economy though not for himself—in iron production.

The Seven Years War had brought a keen demand for iron ; hence Roebuck's call for a full-scale effort at Carron rather than a small works envisaged by the cautious Garbett. Ore samples were sent to Birmingham for assay as a first move ; this in days when the Midland city had a strong stake in ferrous metallurgy as well as in brass. The Midlands also provided Coalbrookdale bellows makers for the blast, millwrights and smelters, and raw materials for first construction such as Stourbridge bricks, together with pig-iron for wrought-iron production until the blast-furnaces became fully operated. Skilled men came from Coalbrookdale and Sheffield " to teach the ignorant Scots the essentials of the work " as historians put it ! A boring-mill was built, a double forge and other small mills set up, and soon a coke-making yard was in use.

In an account of Faujas St. Fond, Swiss geologist and traveller, who toured Britain in the 1760's, one finds a true picture of this

coke production rivalling the Coalbrookdale activity and due to Roebuck's insistence on coke rather than charcoal. St. Fond told how piles of coal were built up like the stacks of forest waste piled by old charcoal burners, with a central flue or air space and other vents for partial combustion or coking, the heaps being covered with coal slack or dust. " As the fire spreads, the mass increases in bulk, swells up and becomes spongey and light, then cakes into one body and emits no smoke."

Carron was thus off to a good start, with Roebuck ever controlling operations in his call for efficiency. All charges of ore and coke were weighed, baskets of coke tipped in at definite times, and molten iron tapped off at prescribed intervals, all a contrast to the old rough smelting in forest hearths and bloomeries. Garbett was more the business manager, finding new capital when it was needed and in 1776 taking over some of Roebuck's shares in Carron when the Prestonpans works involved him in a deficiency of £3,500. " I don't doubt," Garbett rightly maintained, " that in a few years many of this country's people will be seeking for proper places to fix ironworks in the neighbourhood of Forth." Carron went on to produce not only cooking pots and other domestic ware as at Coalbrookdale, but ploughs for Scottish agriculture, cast-iron mill gearing, guns known as Carronades for hurling 68 lb. shot to give a short-range destructive effect, and iron ships which gave birth to the historic Carron Line of steamships.

Yet the anniversary is not merely of a great company but also of the Scottish iron industry as we know it to-day. The whole foundation of 200 years ago was due to the genius of Roebuck; to the accidental or fortunate switching of his attention from the large production of sulphuric acid to iron smelting. The history of Scottish iron would have been one of delay or slow progress had it not been for Roebuck failing to patent his vitriol process, finding his application in the Scottish courts turned down when his own workmen, after absconding with his secret, came to give evidence that the process was being worked elsewhere !

Chemical Grouting

A solution developed by a United States company is used to control water inflow

A. Hegarty

A solution developed in the United States by the Halliburton Oil Well Cementing Company is finding increasing uses. Known as " PWG " it is a grouting solution having many properties that makes it particularly adaptable for the control of water under a great variety of conditions. Water-producing sand formations have been plugged with it so that shafts can be dug under dry conditions while permeable soils can be stabilized to prevent movement during tunnelling or shifting under large weights such as buildings and vibrating pumping stations.

The solution contains no solids, as found in a cement slurry, that can bridge over and plug flow channels in tight water-producing formations and soils, so that penetration of the solution into very small openings is possible. Viscosity of the " PWG " solution is very low, approaching the viscosity of water, such a low viscosity being desirable as it aids in the entry of the solution into the true permeability of water-bearing strata. In addition, the solution does not gradually increase in viscosity with time, as do most resins, very low viscosity being maintained for approximately 95% of its fluid life. Once " PWG " starts to set a very rapid increase in viscosity is obtained and the material gains its full strength 10 min. to 30 min. after the first viscosity increase is noticed.

The setting time of " PWG " can be varied to fit all types of job conditions. Setting times of less than 10 min. to more than 60 min. are possible. Formulae are also available to fit formation temperature con-

Fig. 1.

ditions from 320° F. to 200° F. The solution sets to form a very stiff gel, such a gel being effective in holding back water in slightly-creviced strata as well as permeable rock types.

Very frequently grouting solutions become diluted with formation water as they are being placed. The " PWG " solution can be diluted with water and still give good sets. A 25% dilution, for instance, will give a set product essentially as good as the original solution. Again, at 50% dilution a very good set is obtained although the set time is a little longer. A fairly good set is still obtained at 100% dilution, with the solution taking about 50% longer to set. Even at 200% dilution a soft gel is obtained that is capable of holding back low-pressure water. The ability of the " PWG " solution to give good sets on reasonable dilution with water during injection points toward a more efficient water control treatment.

Set " PWG " is insoluble in water and practically all water solutions of chemicals. The set gel is actually a set resin with water trapped in its structure. Shrinkage of the set material can occur with time when it is exposed to air, but re-exposure to water will

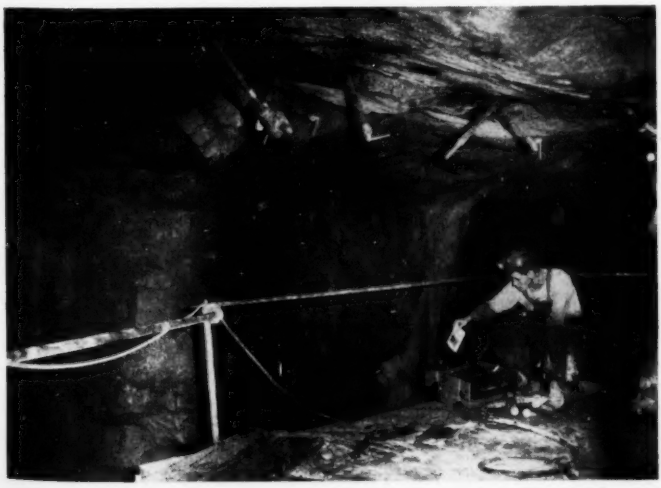


Fig. 2.

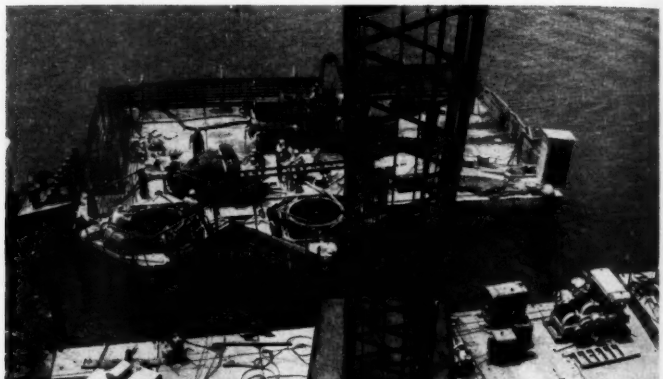


Fig. 3.

cause the gel to reswell. Where water is present in contact with set " PWG ", no shrinkage will occur.

Placing " PWG " in water-bearing strata varies for every application. A thorough study of all conditions should be made before attempting to grout off water or stabilize shifting soil. After the study has been completed a specific " PWG " formula and placement procedure is recommended for the particular application. The solution has been used to shut off water and gas in a formation completely to permit sinking a mine shaft to a greater depth. In this case the water and gas were being produced at a pressure of 700 p.s.i. at 1,500 ft. In another instance, water being produced from a vughy formation at 1,600 ft. below the surface was successfully controlled.

Recently, in the eastern United States, an L.P.G. (low-pressure gas) storage cavern was excavated in hard granite. An extensive and well-planned grouting operation using several " PWG " formulae to fit changing conditions shut off 95% of the water influx. The room was excavated with the base being about 305 ft. below the surface, the roof of the chamber being approximately 45 ft. from

Fig. 4.

the bottom. Water was coming into the cave through fractured rock in part of the overhead and sides. Fig. 1 gives an overall view of the inside of the chamber and Fig. 2 shows the grout pipe in place in the overhead; it illustrates the different angles of the holes that must be drilled to intercept the various water-producing fractures. These fractures range in thickness from a hair line to $\frac{1}{4}$ in. Even the widest fractures were successfully plugged with "PWG". This was made possible through the fact that the gel time of this material can be as low as 1 min.

Another method of treatment is to drill wells from the surface to the desired point adjacent to the planned chamber. Again, casing is set in the hole and the desired grouting area perforated with special jet charges. This technique is relatively new, but it appears to hold a great deal of promise in future grouting operations.

Stabilizing soil beneath steel forms in bodies of water is another problem which has been overcome with this material. Fig. 3 shows a view of construction of concrete piers in a lake in the south-western United States. Difficulty was encountered in sealing the bottom of the steel form where the soil was very sandy and unconsolidated. Fig. 4 shows one of the grout pipes through which a fast setting "PWG" solution was pumped to stabilize the soil and prevent the entry of water into the pier. In this particular case the bottom of the form was 50 ft. below water level.

Although "PWG" has many desirable properties and has been very successful under a variety of conditions, it should not be considered the answer for every grouting problem. For example, water production from large crevices can best be controlled by slurries.

Visual Survey of Bore-holes

Closed-circuit television to the aid of the geologist

Leo Walter

The demand for equipment enabling visual inspection of bore-holes is likely to become the more pressing as a geological aid in the completion of drilling programmes. One firm, however, which specializes in geological surveys, has developed a novel telescope bore-hole inspection equipment, which has proved its value in several instances.[1] Dr. Ing. Leopold Müller, of Salzburg, has co-operated with Grundigwerke, of Fürth, Bavaria, in designing the type B.300 optical bore-hole instrument, which, it is claimed, will be of great value in making geological soundings of drill holes, clefts, and cavities in mine galleries and tunnels for the inspection of rock anchorages and reinforcement in civil engineering jobs, and for general geological exploration work.

The equipment is said to be suitable for establishing rock types and to allow the survey of contacts, seams, cavities, the position of structures, and water seepage within a rock formation. In drilling operations it is claimed that it provides information with regard to core losses.

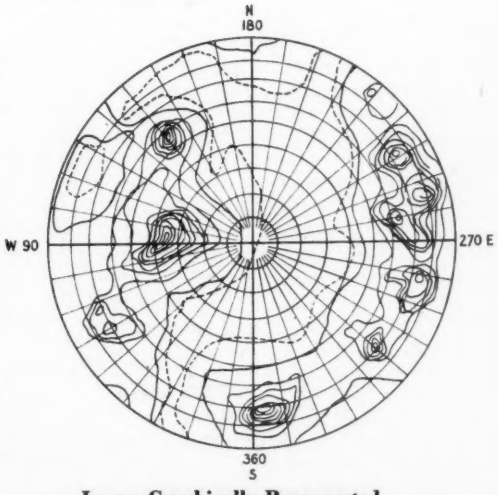
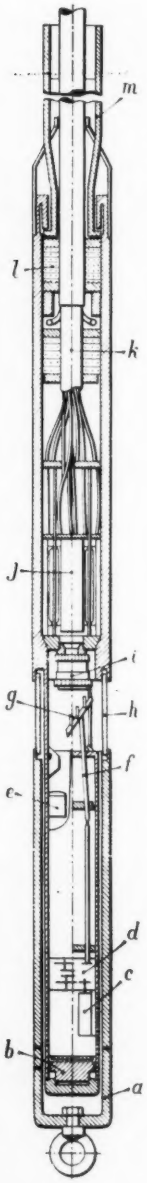


Image Graphically Represented.

[1] See *The Mining Magazine*, Jan., 1960, p. 33.



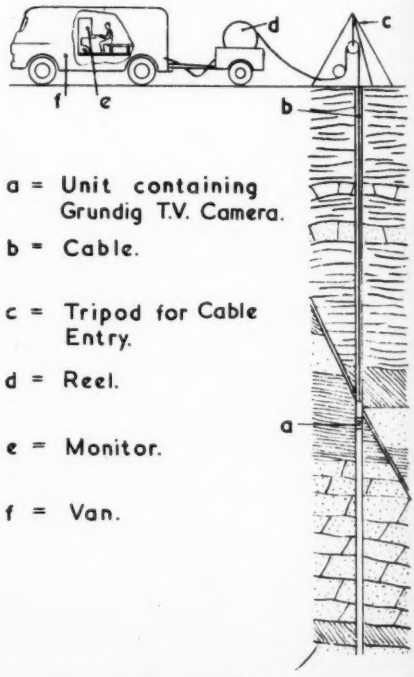
a. Housing
b. Humidity indicator
c. Mirror motor drive
d. Gear
e. Compass
f. Cardan transmission
g. Rotating mirror
h. Window
i. Objective
j. Miniature camera
k. Cable
l. Seal
m. Loop on housing

Bore-Hole Telescope Unit.

The standard equipment will reach a depth of 1,300 ft., making it possible to view directly with stereoscopic vision. Photographs may be taken from the image on the monitor screen and exact observation with all pertinent detail is thus available.

The Müller equipment consists of a housing containing the Grundig TV camera, an optical unit, a unit for indicating orientation and a warning indicator for humidity. Remotely-controlled illumination effects allow close inspection of the bore-hole wall and allow critical distinctions to be made between different sections. A multi-core cable leads to the control unit and to the monitor and the whole video outfit is contained in a van with trailer. It is claimed that the equipment can be in action within about ½ hr. after arrival at the site. Various improvements and additions are contemplated by the makers; for example, the pressure-tight camera housing will be made in several types and different diameters.

A brief summary of specification is given by the makers, in which the main features of the B.300 are described. As regards the size of drill hole in which the unit may be operated, the smallest diameter is 2·6 in. and the greatest diameter is 5 in. (without supplementary arrangements); with such a supplementary arrangement the diameter can be



Equipment in Use.

chosen at will. The greatest depth of hole for which the standard model may be used is 1,300 ft. and it can also be employed under water. The sounding apparatus is 32 in. long, has an outside diameter of 2½ in., and a weight of about 30 lb. It has a cylindrical window, scratch indurated, and a depth-view window can be supplied if required. The Grundig TV camera, which can be used for viewing the walls or bottom of the hole, can be revolved by remote control. There is also an illuminating device consisting of three 14-V bulbs, situated on both sides of a mirror. The strength of the illumination can be varied by remote control and there is also a system by which the inclination and direction of the hole can be measured. The equipment also embodies a moisture indicator.

Pictures are transmitted by means of a 32-wire cable, which is self-supporting and weighs 0·726 lb. per ft. The associated cable drum has a capacity of over 1,000 ft. of running cable and is equipped with a brake and pulley.

The TV and controlling device consists of a video-receiver viewing tube 10 in. by 18 in. by 16 in. and weighing 60 lb. The operator sits at a control desk for handling the camera, illumination, mirror, and moisture feeler, and the control unit measures 10 in. by 18 in. by 14 in., weighing about 50 lb.

The picture-receiving tube consists of a Mini-Resistron type 135, measuring ½ in. by 3½ in. and weighing 10 g. It gives a picture diameter of ⅛ in., the horizontal and vertical retrace having 300 lines and the line-frequency being 15625 Hz (50 pictures per sec.) The necessary illumination strength on an object is 200 lux. Details of 0·1 mm. diameter on the drill-hole walls are recognizable on the screen.

Mobile bore-hole TV equipment has been developed by Messrs. IBAK of Kiel, Germany, using the Müller-Grundig units and is in use for inspection of sewers and underground piping systems. It can be expected that improvements in CCTV equipment will considerably widen its scope in civil engineering work.

Ore-Dressing Notes

(1) *Tailings.*

Backfill at Hecla

An interesting account is given in the *Mining World* of San Francisco for November, 1959, of the new hydraulic fill installation for underground support at the Hecla mine, Burke, Idaho. To mining men the fact that blind stoping should now become possible in the bad ground of the lower levels where over half the ore reserve remains is important, together with lessening dependence on timbering. The mill man will be interested in the use of a duplex piston pump to move the deslimed sands some 9,000 ft. with a rise of 90 ft.

The practical success already obtained includes easing of rock pressures, lessening of rock-bursts, speeded-up production, and lessened dilution of ore by wall rock. Mill tailing can be gravitated to the backfill plant by remote control at up to 31·3 tons per hour with a pulp density of 1·43, the solids having a density of 2·75. Here the tailings are cycloned at 11–12 p.s.i., giving an underflow carrying 50% of the solids at 32% *minus* 325 mesh. This is fed under constant head to a 5-in. by 10-in. duplex pump worked with variable speed control at pressures ranging from 574 to 1,500 p.s.i. The pump delivers to a 3-in. pipeline hung in the 8,600 ft. long tunnel connecting surface with shaft at the 2,000-ft. level, with an overall rise of 90 ft. The pump works at 45 strokes/minute and 40% solids. Pistons, with a steel core and replaceable rubber sleeves, have a life of about 400 hours, as have the etched chrome liners. Wear in this long pipe-line has not been a serious problem, due in the operator's opinion to the lubricating effect of the fine fraction of the solids carried. Provided -10μ slimes are removed from the original mill tailings percolation rate of the liquid from the stopes has not created a problem.

(2) *Testing.*

The Pilot Plant

Thorough testing of an ore-dressing flow-sheet by adequate work on the pilot-plant scale is good standard practice in the development of the modern flow-sheet. The purpose is to check that the process is both technically and economically sound and that the proposed equipment is suitable. In addition,

basic data should be forthcoming with respect to the variables affecting the final design. In a recent article [1] 23 design considerations for the pilot plant are listed. They include the problems of representative feed, alternative schemes, balance of materials, heat, control, instrumentation, estimated capital and operating costs, reagents, and operating manpower.

The fact that so many items are to be integrated in a final design makes it of dubious value to omit the pilot stage. In the past it was not uncommon to make unit studies of the various operations and from that to proceed to final assembly. Modern milling by its much greater complexity requires a far more detailed elucidation of the facts and of their interdependence if a really satisfactory mill is to be designed. The pilot plant is ideally erected on the proposed treatment site. In such a case local water is used on fresh ore and the quantity of ore available for test is not a major problem. This, however, presents a number of difficulties. It may not be possible to command the required breadth of experience in an isolated locality. The various systems of control which should be tried out can best be tested where the resources have been developed to deal with a wide variety of problems. It is sometimes not practicable to ensure a sufficiently large tonnage of the representative ore for full tests at a distance. Miniature machinery has been developed to the point where it is not difficult to scale up in many cases. If the plant is located near the mine the site must be accessible, utilities available, and the necessary skilled manpower on supply. Where sulphide ore is being treated, as is usually the case, it is most desirable to have the pilot plant near enough to the mine to minimize the effect of oxidation.

The usual rule of thumb is that pilot-plant tests should be performed on at least 50 times the scale of bench and unit tests and that full-scale plant should have a capacity of not more than 50 times that of the pilot plant. This generalization cannot always be realized, but it must be borne in mind that operating troubles always accompany a large jump in the scale of operations. Pilot-plant work can be performed on quite a small trickle of ore but it does not give a consistent picture of middlings returns and slurry blends. The further difficulties include the limited quantity of final product. If a smelter wishes to have a fairly large sample for its tests this may be of importance. The same would apply where detailed chemical analysis were needed for upgrading the concentrates to a tight specification and for market surveys and by-product investigation. A scale of not less than 10 tons daily and up to 25 tons per day is frequently found to be the minimum safe size of a pilot plant. A compromise used by some workers is to put only the novel unit operations through pilot stages and to rely on experience and integration for the more common sections of the flow-sheet.

As the pilot plant is used intermittently special care with regard to cleanliness and possible corrosion is desirable. Piping can well be of rubber or plastic. In this form it is easily worked and adapted to the changes necessary in testing alternative methods. Corrosion is more or less limited with plastic piping but rubber can in special circumstances lead to a contamination of product subjected to flotation. If there is a suspicion of this there must be no reaction between any of the organic reagents used and the plastic concerned. Pipe diameters should be kept down to the minimum required for full-scale running and horizontal runs must be avoided. It is good policy to make all piping self-draining and to avoid very gentle crests where material could lodge and accumulate. Instrumentation must be simple and reliable. The recommendations for permanent instrumentation of the final mill can often best be developed by the simple methods of vanning, pulp weighing, and the use of a pH meter. Valves are important as means of control and blending and must have careful attention. In the final plant valves are not used for controlling flow rates and must thus either be fully on or fully off. An exception to this is the type of automatically-controlled valve used in pH work and for such purposes as spigot regulation in hydrocyclone classification.

From the pilot-scale work the full capital and operating costs should emerge and the pilot testing and recording must have this very much in mind. The economics of the process are of primary importance and the secondary value of the technical data must always be recognized if a viable operation is to result. This does not mean that the technique of milling must be in any sense neglected or cut down. The point is that it must not get out of proportion to the overall costs which can be borne by the complete

[1] MACDONALD, R. D., and STEVENS, F. M. *Min. Engg.*, May, 1959.

operation. The pilot plant should have available simple shop equipment for handling not only the small breakdowns liable to occur in any plant but also for the adaptation of piping and pump speeds and a host of other details to changes in flow lines. Because the equipment is always being pulled around the safety provisions must be given a special thought. Pilot-plant operation is hazardous and a well-trained crew is important if the effects of the "hook-up" changes always going on are to be properly looked after. Plenty of room should be left around all the equipment and there should be ample points for cleaning down and plugging in inspection lamps.

During the test work it is almost impossible to collect too many data, as it is hardly feasible to say during the active period of development of test just what will be wanted. Provided sampling has not swamped the analysis of the work and fact-finding has not become so voluminous as to obscure the issue all figures that affect rates of reaction should be recorded. These would include temperatures, changes in quality of water, level readings, pressure readings, and log books of the various events. Sampling must be carefully studied in order to ensure that representative samples are taken at each essential point and in the proper manner. They must also be co-ordinated in time so that one group of samples taken at various lengths along the flow line does build its picture of the same material in progress along that flow line. Otherwise the study of changes which are occurring as a result of application of the process cannot be made. The sampler should be a trained individual with no other duties. Samples are nearly always best taken regardless of the immediate appearance of the flow line. To wait until everything looks at its most favourable is to bias the operation. It might be far more important to know what was happening when conditions looked most unfavourable as the correction of untoward circumstances is one of the justifications for thorough pilot-plant testing. Samples must be taken sufficiently close to one another to assure that they deal with fluctuations over a running period.

Data from all this work are at their best when they are properly organized, tabulated, and cross-referenced and also presented in graphic form. Variance of any detail of unit should disclose its effect on the operation. In order to get this data together in an orderly manner each operator should have cyclo-styled forms which must be filled in according to a prescribed method that has been thought out at the top level so as to give the fullest information when the various daily returns are collated.

In the analytical section of pilot-plant work two types of assay are required. There are the control assays linked with sizing and so forth, which are feeling the pulse of the current operation. There are also the detailed and special analyses made to track down the physical and chemical causes of unexpected variations in operation efficiency. It is tempting to defer reporting and working up of the results to a late stage of operation. This, however, may be undesirable in that unless a full report from the man in charge is given day by day and is crystallized by the discipline of integrating this work daily the testing engineer is unlikely to see what could be done to bring the work nearer a final settled plan. One advantage of a localized pilot plant is that, if the space can warrant it, it is still there when needed to deal with new problems that arise after the full-scale plant has been constructed and is at work.

(3) *Flotation.*

An Interesting Application

Writing in *Nature* (October 3, 1959) Dr. F. Sebba describes the use of froth flotation in the concentration of inorganic ions from aqueous solution even where they are very dilute. The collector used is a surface-action counter-ion which must be introduced in a dispersion not exceeding its critical micelle concentration. If a collector soap is used it should either be freshly prepared in alcoholic solution or, better, dissolved in a non-polar solvent such as petrol ether which is then evaporated and replaced by a low-chain alcohol. If air is now dispersed into the aqueous solution carrying metal ions and collector the latter tends to concentrate at air-water interfaces with its charged group orientated to the water phase. It then attracts the charged cations from solution and transports them to the surface where either a froth or a scum is formed. The miniature flotation process is completed by removal of this insoluble soap with its relatively high concentration of inorganic ions. The only difference between it and normal flotation is that at the start there is only a solution, the reacting solid surface being formed by the collector. Providing it is counter-ionic to the material being con-

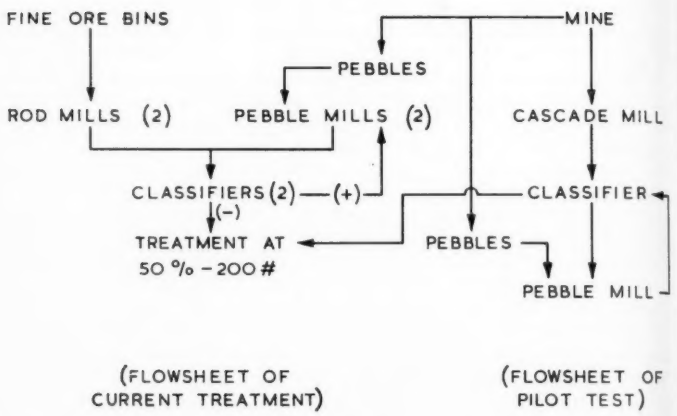


Fig. 1.—(a) and (b).

centrated, the nature of the reagent is not critical, though the longer-chained compounds may be more effective in some cases. For floating anions a cationic collector such as an amine could be used. Success is reported in the concentration of a number of elements and ion-groups. Selective concentration is effected by addition of the collector in small doses.

For success the collector must not only be fresh and introduced in molecular dispersion but must also not be allowed to fall back from the surface into the aqueous phase lest it concentrates to form a stable colloid. Bubbles should be very small and should be removed continuously. Solution temperature must be below the melting point of the soap which is formed.

The author suggests that besides giving a means of eliminating filtration it offers an alternative separating procedure, applicable to concentrations as dilute as parts/10^7. This could be of analytical use and might help in purification and by-product processing. Even the possibility of floating metal ions from seawater is brought nearer.

(4) *Comminution.*

Conventional *versus* Autogenous Grinding

In the *Western Miner* for March, 1960, an interesting comparison is reported between the cost of standard grinding and that in which, on a laboratory scale, the Hardinge cascade mill was used. The flow-sheets (Fig. 1 (*a*) and (*b*)) are between a full-scale operation now treating 1,500 tons daily and results obtained by treating several hundred tons at Ottawa. Costs in the latter case are extrapolated to allow for the special need to store a three-day supply of ore in the fine-ore bin and to produce grinding pebbles.

The test cascade mill had a diameter of 6 ft. and a drum length of 2 ft. Grinding pebbles are *minus* 3 in. *plus* $1\frac{3}{4}$ in. and are consumed at a rate of 3·3% of the weight of fine ore milled. Using the accepted definition of autogenous as "self-produced" or "independent," the comparison is between primary grinds to *minus* $\frac{1}{4}$ in. followed by the 1 (*a*) flow-sheet and direct reduction of *minus* 12 in. run-of-mine ore. Summarizing the test results given by B. G. W. Robinson the capital cost of the existing mill is $1,233,300 as against an estimated $885,300 for the all-autogenous scheme and the installed horsepower 1,290 as against 1,260. Operating comparisons are not given but might form the subject of a later paper.

New Australian Blast-Furnace

Australia's steel-making capacity was raised to more than 3,000,000 tons a year when a new blast-furnace commenced operation at the works of Australian Iron and Steel Pty., Ltd., the principal subsidiary of The Broken Hill Proprietary Co., Ltd., at Port Kembla, N.S.W., recently. Costing £A10,000,000, this No. 4 furnace is Australia's latest and largest and is now a major feature of the Port Kembla steelworks. It forms part of the current development programme being undertaken in that area by The Broken Hill Proprietary Co., Ltd. Having a capacity of over 1,700 tons of pig iron daily or approximately 600,000

New Furnace at Port Kembla.

tons annually and incorporating many new operational and design features it will provide employment for about 300 additional men.

The furnace consumes approximately 1,000,000 tons of iron ore or sinter, 500,000 tons of metallurgical coke, and 160,000 tons of limestone a year. In addition 1,750,000 tons of preheated air will be blown into the furnace, the weight of air being greater than that of the combined raw materials. The furnace proper will at any one time hold 2,000 tons of iron ore, coke, and limestone and the anticipated casting programme envisages that the furnace will cast six times a day and yield approximately 300 tons of molten pig iron per cast. Its construction was necessary in order to enable the Port Kembla steelworks' steel ingot-making capacity to be raised, thus bringing closer Australia's self-sufficiency in all classes of steel products. The annual steel-making capacity of the works is currently 2,050,000 ingot tons.

J. GRINDROD.

Book Reviews

Methods in Geochemistry. Edited by A. A. SMALES and L. R. WAGER. Cloth, oct., 464 pp., illustrated. Price 94s. London: Interscience Publishers, Ltd.

This symposium of ten articles each around 12,000–15,000 words, by a dozen authors

mainly from A.E.R.E. (Harwell) and Oxford University, sets out to describe various advanced methods of analytical research now employed in the study of the chemistry of the earth. The basic idea of the book is a good one, for many of these modern techniques are but little known to the generality of geologists and chemists.

Among the chapters of widest interest is one by E. A. Vincent on "Analysis by Gravimetric and Volumetric Methods, Flame Photometry, Colorimetry, and Related Techniques," in which the author builds upon the U.S.G.S. Bulletin "The Rapid Analysis of Silicate Rocks," by the addition of refinements and new procedures of his own devising. Another on "Some Modern Chemical Separation Methods," by F. W. Cornish, is concerned with ion exchange, solvent extraction, and paper chromatography. More specialized contributions relate to "Spectrochemical Analysis," "Fluorescent X-ray Spectrography," and "Polarography." Nuclear processes are ably dealt with in chapters on "Stable Isotope Chemistry and Mass Spectrometric Analysis" by K. I. Mayne; "Mass Spectrometric Isotope Dilution Analysis," by R. K. Webster; "Radiochemical Methods," by S. Moorbath; and "Radioactivation Analysis," by D. Mapper. One or two of the papers would have benefited somewhat from closer proof-reading, but all are lucid and illuminating.

The introductory article on "Collection and Preparation of Material for Analysis" unconsciously exposes a fundamental weakness of much academic geochemical research. We read in it that: "Few geologists use any standard sampling methods but (? many) vary their practice according to the nature of the outcrop. In the simplest case of an extensive mass of homogeneous rock, one fresh piece large enough for several types of analysis would be sufficient." How, we may ask, does the geologist know that this mass is homogeneous, without sampling it? This complacency is dangerous. The field of geochemistry is littered with fallen hypotheses initially erected upon bad sampling and a few examples from the works of eminent practitioners might well have been quoted as warnings. As the reviewer wrote in this journal some years ago, "If a mining company were to be content with the standards of sampling that are found in many petrological and geochemical studies its solvency would soon be in doubt."

Each chapter concludes with several pages of selected references and there is a good index. The price seems unduly high.

C. F. DAVIDSON.

Principles of Geochemical Prospecting. By I. I. GINZBURG, translated from the original Russian by V. P. SOKOLOFF. (International Series of Monographs on Earth Sciences, no. 3.) Cloth, octavo, xviii + 311 pages, illustrated. Price 70s. London: Pergamon Press, 1960.

The Russian work of which this text is a translation was published in mid-1957 in an edition of 10,000 copies, price 11r. 70k. (marketed in Britain at 9s.). It is a book which exhibits many signs of hasty writing and which is not at all easy to read. Despite the valiant efforts of the translator to clarify obscurities, the rendering into English words is no more lucid than the original and, particularly in the earlier chapters, a good deal of his text bears but a superficial resemblance to the English language. In the reviewer's opinion, if this had been initially a British or American work it would have failed to find a publisher.

The publisher's "blurb" informs us that "the book constitutes the first effort to cover the entire subject of geochemical prospecting comprehensively, including hydrochemical, biogeochemical, and geobotanical methods"—no reference being made to a highly competent American text with the same title, by H. E. Hawkes (*Bull. U.S.G.S.*, 1000-F, 1957, 131 pp., price 40 cents). The omission may reflect the not uncommon belief that experience in this field of research is further advanced in the U.S.S.R. than in the West; but a perusal of the translation provides no sound foundation for this tenet. Had an effort been made to summarize the Russian researches in a well-digested presentation the book would certainly have been of general interest to all students of economic geology. Unfortunately, however, most of it is no more than a hurried scissors-and-paste compilation which only the specialist can be expected to plod through. An appendix on "Rapid Methods of Determining Pb, Cu, W, Mo, and Ag in the Field" omits the name of the writer thereof. It is by A. I. Pokrovskaya.

The English edition is much better dressed than the Russian original. All diagrams have been re-drawn and the printing and paper are

good. But, these superficial aspects apart, the standard of publication is Russian rather than British. One finds very frequent mis-spellings, a senseless pepper-potting of punctuation, an unexplained use of strange, non-English words such as illuvial and deluvial and repeated inconsistencies of transliteration, the last too often resulting in a name being spelt in more than one way on the same page. On the first two pages of the bibliography there are 24 mis-prints, a number far in excess of that pardonable in a costly British book which purports to be an international monograph.

C. F. DAVIDSON.

Oil Well Drilling Technology. By A. W. McCRAY and F. W. COLE. Cloth, octavo, XI + 492 pages, illustrated. Price 80s. Norman, Oklahoma: University of Oklahoma Press.

This book presents a comprehensive and thorough treatment of the technique of oil-well drilling. Academic aspects that might perhaps be expected to dominate in a University Press publication are suitably proportioned by the authors in their handling of the theory and practice of their subject. Co-operation with the American Association of Oil-well Drilling Contractors provided a great wealth of experience and data on which they were able to draw.

The following chapter headings indicate the scope of the work :—Rocks and fluids of oil and gas provinces, discovery of petroleum, acquisition of leases, earth temperatures, pressure relations in the earth and in bore-holes, drilling fluids, well planning, power plant, rotary operations, hoisting operations, drilling-fluid circulation, drilling practices, fishing tools and practices, coring, formation evaluation, development of drilling systems, pressure surges and anomalies, casing and casing-string design, cementing operations, drilling economics.

In these chapters experienced drillers, as well as students of oil-well drilling, will find the answers to many of their problems and the cost percentage charts in the chapter on drilling economics are of value to all concerned in oilfield operation and management.

W. E. GOODAY.

☛ Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Engineering Log

Nuclear energy control applications have been extensively studied in Great Britain, although delays in Government work rules which would regulate the installation of radioactive sources have caused some prospective users to hold back. One of the most interesting installations was made by Ekco Electronics for the oil industry. The Iraq Petroleum Company's 555-mile pipeline runs from Kirkuk to Tripoli and interface travel is monitored by nine fluid-density gauges. Gamma-radiation measuring heads have been fitted at each pumping station and at the terminal, at two places, at the switch point, and 3,000 yd. upstream. The two products in the line absorb gamma rays differently at the interface. Density variations of specific gravity as low as 0·001–0·002 can be detected. Alarm circuits on the Ekco equipment alert the station operator as soon as the interface nears the advance warning point and on arrival at the switch point. Upstream of the radiation measurement heads are temperature sensors, which compensate for changes in temperature. During the first tests it was found that the installation saved some 80,000 gal. of crude oil. One unlooked-for advantage was that the detectors located the exact position of sludge drifting from storage tanks into the pipeline.

* * *

At the Hughes Aircraft Company's Culver City plant in California a unique combination of reader, computer, and plotter has been made to save time in machine data reduction. The high degree of mechanization is effected by means of perforated paper tape and works as follows :—As test flights are made raw data are recorded on an oscillograph record which is fed to a special reader. At this point values of key points are recorded on the perforated paper tape. This tape is then fed to a Burroughs E101 electronic computer. The E101 beats the data against an appropriate prepinned programme. The reduced output data, once again on perforated tape, go to another reader, whence they are fed through a converter and made ready for output to an automatic plotter. In addition to handling flight test data for the evaluation of systems the computer can cope with radar, communications, electronic tube research, ground systems, and human engineering. Before the

advent of the E101 data reduction staff needed seven desk calculators and a week, instead of 24 hours, to solve an engineering problem.

* * *

One outcome of the International Geophysical Year's work was renewed interest in the huge tonnages of manganese nodules on the seabeds of many oceans at a depth averaging 12,000 ft. Apparently the manganese gets into the sea from riverine sources, by underwater volcanic action and from deep springs. It precipitates as colloidal MnO_2, sinks, and collects into brownish-black accretions of golf-ball size. As this takes place the negatively-charged manganese colloid attracts metals of positive ionization, notably cobalt, copper, and nickel. The discoveries in the South Pacific were made with the aid of deep-sea photography. Testifying before a United States Congress Committee Dr. R. E. Revelle showed a nodule which assayed some 25% Mn, ½–1% Ni, ½–1% Co, and 1% Cu, and said that this material ranged in quantity from 120 to 15,000 tons/square mile over millions of square miles of the Pacific Ocean. The recovery and processing of this material would, at present prices, hardly be economic as a straight manganese product and a lot would need to be known about the associated minerals and their amenability. There is also the formidable question of international law concerning ocean space.

* * *

The U.S.S.R. State Planning Committee, a far-reaching organization, includes under its direction one agency called the Council for the Study of Productive Forces. Its director, M. Mitrotan Davydov, is a specialist in water resources and it was one of his colleagues, M. Nikolai Romanov, who was responsible for the recent suggestion, which attracted some attention in the United States and more especially in the new state of Alaska, for the diversion of the Gulf Stream. This is not a new idea, but is a vast one. Romanov points out that one-quarter of the land surface of the earth is lying waste because of the operation of frost and this area includes seven-tenths of Alaska, six-tenths of Canada, and 47% of the Soviet Union. The Gulf Stream and the Kuro Shiwo currents, deriving their warmth from the equatorial areas of the Atlantic and Pacific, could, at least in theory, provide the necessary heating system to free this territory from its ice bonds. Murmansk, on the Kola Peninsula, lies well within the Arctic Circle and is open all year as a result of the action of the Gulf Stream. The Kuro Shiwo, on the other hand, strikes a cold current in the Pacific which diverts it from the Asian coast. One branch only flows into the Sea of Japan and this alone, according to Romanov's scheme, could warm the Soviet Union's Pacific coast if it flowed into the Sea of Okhtosk. The cold waters of the West Okhtosk current, breaking into the Sea of Japan through the Strait of Nevelsky, prevent this effect and carry the northern climate south. By blocking the Strait of Nevelsky the Shiwo could be diverted. Romanov's scheme envisages warming not only the Russian Primonje Territory but also Japan's northern island and Northern China. He proposes to overcome the problem of electric energy sources for the project by making use of the moon's gravitational field. The Strait's narrowest point is four miles wide and 85 ft. deep. A dam would be built, with gates opening one way, towards the Sea of Okhtosk. Valves working against the ebb would trap the tide. Temperatures would rise gradually from the present January average of 10° below zero. A similar dam across the Bering Strait would melt the North Pole ice cap from the other side, bridging Russia's Chukotlea and America's Alaska and using the Gulf Stream warmth. The Bering Strait is 35–50 miles wide and 130 ft. deep. This time the moon's gravity would be inadequate, but the volcanic area of Kamchatka-Kuril, with 67 active volcanoes, is regarded as a suitable source of electric power. When Governor Egan, of Alaska, requested Washington to consider the project last year American engineers pointed out that some of the side effects would be the conversion to unwatered desert of the Mediterranean and Southern California. Director Davydov's scheme for the improvement of our imperfect planet must evidently be delayed by broader international considerations such as the possible rise of mean sea-level.

* * *

A new 130-ft. lighthouse tower, situated half a mile from the old lighthouse, is being built off the headland at Dungeness, near the site of the proposed new British nuclear power station. The new structure will guard the western approach to the Straits of Dover,

where currents build up to 8 knots as they eddy across the sandbanks where fog frequently obliterates all sight of land. This will be the world's most up-to-date lighthouse. The tower planned will be formed of precast concrete rings 12 ft. in diameter, 5 ft. tall, and 6 in. thick, and reinforced with steel cable ; at the top will be two rings cast with 60 fog speaker signal apertures, surmounted by a flared-out structure holding the lamp. Since the black and white banding will be incorporated in the concrete, no repainting will ever be necessary. A control panel inside the spiral base of the lighthouse will take over the keeper's function of working the light, fog signal, and radio beacon, either automatically or by remote control. Current is supplied from public power lines and in case of a failure a diesel generator cuts in. If the generator fails emergency batteries supply current. Most unusual feature of the new building will be the light. A Xenon arc lamp producing 750,000 candlepower (a 3,000 watt movie-projector lamp) is to be used and will flash on and off by means of an ingeniously devised circuit. A small stationary drum lens will be placed around the arc, instead of the familiar rotating system housing vaporized kerosene continuous-burning lights. The first drift of fog sets off the fog detector, which is to be mounted at the top of the base. A 20-in. searchlight, throwing a narrow beam of some 35,000,000 candlepower, and a telescope focused on a photocell make up the fog detection equipment. Both light beam and photocell amplifier are modulated by a 50-cycle supply of power, so that only the bounced-back searchlight illumination is measured, as the outgoing beam hits the fog's water-vapour particles and is reflected. Daylight has no effect on the mechanism. When a pre-set limitation of visibility range is detected by the device a motor generator is automatically switched on and sends the fog signal booming across the water.

* * *

At Stevens Institute of Technology, Hoboken, New Jersey, simultaneous control by one driver of 12 or more powered cars, coupled together so as to form a " combat support train," is under investigation. The Institute is working under a one-year $750,000 contract with the U.S. Army Transportation Research Command. The train is designed for long hauls and would travel on various surfaces, hauling up to 100 tons of cargo at a maximum speed of 25 m.p.h. The driver would be seated in the cab at the head of the line and would control speed and steering of all cars in the train. Units forming the train would be separable from it and at the destination would be driven away individually. Various solutions to the problems involved in the design will be studied at the Institute and a programme set up to test any solutions that appear workable. Conditions for testing will be made to simulate hills, valleys, sharp curves, icy slopes, and other hazards of travel. Controls must be developed to solve such problems as cutting the power of, and perhaps even braking, some units which are travelling down hill, while simultaneously stepping up power of other units which are travelling on the level or uphill. Advantages of the truck train are economy of manpower, ability to operate on almost any road or surface, and increased efficiency in the use of highways. A closely-coupled train would occupy about one-fifth of the highway length required by an equivalent military convoy of individual vehicles.[1]

* * *

Pioneer V, America's artificial planetoid, was launched successfully in its orbit between Earth and Venus on March 11. Until Pioneer V has passed out of range of trackers the American scientists responsible for it will be entirely dependent on Britain's Jodrell Bank for information. In fact the British radio-astronomical station is the only one in the world able to maintain contact over inter-planetary distances, both to receive signals and to send out command signals to the satellite to switch its transmitter on and off. A three-stage Thor-Able was used to launch the satellite from Cape Canaveral and it was detached from the third stage by an impulse triggered from Jodrell Bank. On board are two transmitters controlled in this way, one of 5 watts power, for use in the first week of flight, and the other of 150 watts to operate for five minutes each day after the first week. Signals are expected to reach the receivers from distances up to 50,000,000 miles ; four large solar cells in paddle-wheel vanes power the transmitters. The satellite contains considerable investigatory equipment, including a

[1] *Contractors and Engineers*, May, 1960.

high-energy radiation counter, an ionization chamber, Geiger-Mueller tubes for medium-energy radiation measurements, a micro-meterorite camera, and a magnetometer. Pioneer V is scheduled to orbit the sun in 311 days at an average speed of 70,000 m.p.h., covering 527,000,000 miles each round trip and making its closest approach to the sun, at 74,700,000 miles distance from it, on August 9 next. Farthest point from the sun, on January 16, 1961, is expected to be 93,000,000 miles. The closest point to Earth in its orbit will be about 46,000,000 miles and farthest point from Earth about 186,000,000 miles when Earth and Pioneer V will be on opposite sides of the Sun, National Aeronautics and Space Administration has stated. The closest approach to Venus will be between 6,000,000 and 7,000,000 miles. (Mean distance of Venus from the Sun is 67,000,000 miles and of Earth from the Sun 93,000,000 miles.) It will take several months to determine finally the trajectory of the satellite, however, because it will be subject to gravitational pull from Venus. Nonetheless, tracking should be possible until the perihelion is reached in 151 days. After that time no contact will be expected until Pioneer V turns back towards Earth. One orbit will have been completed by January, 1961, but by this time Earth will be in a different position on its larger orbit, so it is estimated that no contact will be resumed until January, 1963. By this time the distance between Earth and Pioneer V will be 50,000,000 miles or less once more. It is thought that the transmitter will still be in working order at that date. The estimated life of Pioneer V is given as 100,000 years and it should remain in orbit until it approaches close enough to Earth to be burned up in the atmosphere. In contrast to Pioneer V's 50,000 000 miles transmission the Soviet Lunik I and U.S. Pioneer IV achieved tracking records of 396,000 and 402,000 miles respectively, after which they orbited the sun in silence. Both these satellites travelled between Earth and its outer neighbour Mars. Pioneer V differs from them in being inside Earth's orbit, closer to the inner planet Venus. Russia's Lunik III was 290,000 miles from Earth when the hinterland of the Moon pictures were taken and transmitted. In the first week of May, with Pioneer V 8,000,000 miles from Earth, signals were still being clearly received at Jodrell Bank.

News Letters

BRITISH COLUMBIA

June 9.

Lillooet.—The Howard vein has been exposed for a length of 600 ft. in trenches and stripping done on the property of the Ace Mining Co., Ltd., in the lower Bridge River Valley. The work is being done by Bralorne Pioneer Mines which holds an option to purchase a controlling interest in Ace Mining. Widths varying from 6·5 ft. to 9·0 ft. have yielded average assays of 0·4 oz. gold per ton with some silver and antimony, both ends being open to extension. The structure, exceeding 20 ft. in width, is considered to be ideal prospecting ground by the Bralorne engineering staff and the vein, consisting of a silicified shear zone in greenstone, has been described as "one of the best-looking surface discoveries in many years." The structure has been intersected by diamond drilling at a vertical depth of 200 ft. and, although the assays were slightly lower than on surface, the material is of ore grade. An immediate start is being made in driving an adit to explore at depth. The Bralorne Pioneer operations produced 12,690 oz. gold in April for one of the most successful months on record. Operating cost continues to decline and the more favourable dollar exchange is adding to revenue.

Similkameen.—The discovery of palladium in spectrochemical analysis of a sample of high-grade ore cut from solid sulphide in a vein on the property of Friday Creek Development, on the Hope-Princeton Highway, ten miles south of Princeton, may prove to be of more than academic interest. The assay was run by the analytical and assay branch of the B.C. Department of Mines and showed the following metal content: 20·9 oz. palladium, 7·14 oz. gold, and 10·9 oz. silver per ton with 52·6% copper. The area is known to contain considerable bornite, which could account for the high copper assay. Mr. Douglas F. Hameling, the president of the Friday Creek company, is directing the work and is convinced the deposit will prove to be commercial in its copper content and that any mining operation will benefit materially through precious-metal by-products. The ground is being cleared of overburden by bulldozers and a programme of diamond drilling will follow.

Nicola.—A progress report, dated May 9, has advised shareholders of Craigmont Mines of a gratifying increase in both the quantity and grade of the ore reserves in the property near Merritt. Mr. E. P. Chapman, Jr., of the consulting engineering firm of Chapman, Wood, and Griswold, at that date estimated "semi-proved" reserves at 17,034,000 tons assaying 2·04% copper and 19·8% iron. In mid-January these reserves were estimated at 13,374,000 tons averaging 1·80% copper and 20·1% iron. The addition has come through the discovery of what appears to be an entirely new and more deep-seated ore-body separated from the original deposit by some 400 ft. In his report Mr Chapman states: "In addition to narrow comparatively high-grade ore on the north limb of the main ore-bearing anticlinal fold, substantial ore intersections have been encountered in what appears to be a synclinal trough to the north of and below the original zone. The new ore horizon has been partly delineated 400 ft. to the west and is open

at both ends. It is indicated that there may be important additions to ore reserves in the newly-discovered structure."

Kamloops.—The commencement of production by the Bethlehem Copper Corporation in the Highland Valley appears to be considerably closer following the payment of $350,000 by the Sumitomo group of Japanese companies for 300,000 Bethlehem shares. A drilling programme is to be instituted at once on the "A" zone, which is situated between the Jersey and East Jersey zones, explored by underground entries in the past two years. Various options have been given Sumitomo on consideration it expends between $7,500,000 and $9,000,000 on the project. During the year ended February 29, 1960, Bethlehem expended $682,073 on exploration and development. At February 29 last the company had issued 3,560,714 shares of the authorized capital of 6,000,000 shares of a par value of 50 cents. each.

Greenwood.—Consolidated Woodgreen Mines is making regular shipments of copper concentrate to the Tacoma smelter to a value of approximately $1,000,000 annually. Monthly operating profits in excess of $20,000 clearly indicate the efficiency of an operation treating 650 tons daily with heads of 0·8% copper and values of $1·50 per tons in gold and silver. Concentrate shipments grade between 26% and 28% copper with better than 1 oz. of gold and 4½ oz. of silver per ton. The milling rate is to be advanced to 750 tons daily within three months and, as overburden is stripped in advance of mining in the four pits readily adjacent to the mill, it is planned to utilize the full 1,000 tons of daily capacity. The property commenced production in 1901 and in the following 17 years produced 67,827,575 lb. of copper, 158,912 oz. of gold, and 619,772 oz. of silver from 3,772,575 tons of ore smelted. The company at that time operated its own smelter in Greenwood. At 1960 metal prices the value of output is approximately $26,500,000.

Woodgreen Copper Mines, Ltd., commenced operation in the spring of 1957, but were compelled to close in the summer owing to declining metal prices and the heavy burden of debt. Since the new company was formed a year ago, some $300,000 has been expended in pit preparation, additions and improvements to mill buildings and plant, and in construction of homes for staff. Ore reserves are estimated at 1,800,000 tons grading 1·0% copper with $1·50 in previous metals.

Anglo-Turkish Development has acquired an option to purchase the Anamolay group of claims in the Greenwood area from West-Coast Resources, Ltd. The company's interest in the property resulted from the recommendation of Dr. Hans Lundberg of Lundberg Explorations, Ltd., which has conducted an extensive airborne geophysical survey of the property. Unsettled conditions in Turkey are responsible for lack of activity at the company's holdings in that country.

Trail Creek.—Mid-West Copper and Uranium Mines resumed mining and milling on May 16, following the conclusion of an agreement with experienced operators for the mining and milling of copper-gold ore from the Velvet mine on contract. More than 1,000 tons was immediately available and a further quantity was already drilled for blasting in the stopes. The company hopes to increase income materially through the use of a large part of its milling capacity for the custom treatment of the ore from an adjoining property, estimated to be in excess of 200,000 tons. Mid-West also plans to pursue the development of its Swansea copper prospect near Windermere.

Nelson.—A new producing mine will be established in south-eastern British Columbia if the Rimrock Mining Corporation is successful in its quest for funds to place a 35-ton mill at the Spokane mine, near the south-east end of Kootenay Lake. Shipments of ore by former owners are officially reported at 1,783 tons containing an average of 0·513 oz. of gold and 9·95 oz. of silver per ton with 18·2% lead and 0·75% zinc. Mr. D. J. Fulton, the president of the company, says there is at present 15,000 tons blocked out that will bring $32·00 per ton. The mine is opened by six adits. The company also owns a 48-claim silver-lead prospect 7 miles south-west of Cranbrook, on which a recent gold discovery has been reported. Rimrock is capitalized at 5,000,000 shares of no par value, of which 1,500,000 shares have been issued. Of this figure, 900,000 shares are held in escrow subject to release by the superintendent of brokers for British Columbia. The company has received authorization to sell 1,000,000 shares of capital stock to finance the work programme in hand.

Vimy Explorations has acquired an option to purchase the London Hill group of claims in the Nelson area on a 7½% royalty payable out of net smelter returns. The group includes such well-known former shippers as the Panama, Empress, London Hill, and Silver Glance. Immediate underground development is to be undertaken with a view to making shipments of high-grade ore. The company is also developing a copper prospect adjoining the Aberdeen mine, near Merritt.

Yukon.—Another major effort is to be made to recover the gold from the lode responsible for the fabulous placer gold in the Klondike and tributary rivers in Yukon. Klondike Lode Gold Mines has been incorporated in British Columbia with an authorized capital of 5,000,000 shares of a par value of $1 each. Issued for properties are 900,000 shares and a firm underwriting has been received for 1,000,000 treasury shares at 10 cents each. The company is to investigate the "hot" ground between Eldorado and Bonanza Creeks, including Lone Star Mountain. Mr. Gordon R. Hilchey, consulting geologist, has made a close study of the area for the new company. His conclusion closely parallels that of other geologists: "Most of the placer gold must have been derived from two major local sources: a hill on the Bonanza-Eldorado divide and the Dome at the head of Kunker, Dominion, Sulphur, and Quartz Creeks." He has recommended an immediate expenditure of $60,000 on exploration.

Alaska.—The New York-Alaska Gold Dredging Corporation recovered gold and silver from three Kuskokwim dreding operations to a value of $417,692 in 1959, but suffered a net loss of $78,836. A further loss is anticipated in 1960, but the essential dead work now being done is expected to prepare the way for accelerating profit commencing in 1961. The company has made substantial investment in Canadian mining development and has advanced $84,242 to its own wholly-owned subsidiary, New York-Alaska Mines, Ltd.

EASTERN CANADA

June 23.

Ontario Gold Output.—During April the 30 producing gold mines in Ontario milled 779,487 tons of ore and recovered 218,393 oz. of gold and 42,997 oz. of silver, together valued at $7,526,262.

Porcupine.—McIntyre Porcupine Mines reports a profit of $2,411,782 for 1959, the mine output for the year being valued at $8,791,762. A copper-bearing zone on the property averaging 1·2% copper with 0·03 oz. of gold per ton has been outlined between the 1,125-ft. and 2,375-ft. levels.

At Dome Mines 712,900 tons of ore was treated in 1959, operations resulting in net earnings of $1,884,326. At the end of the year the ore reserves were estimated as 2,494,000 tons averaging 0·26 oz. in gold per ton.

Kirkland Lake.—The report of Kerr-Addison Gold Mines for 1959 shows a profit of $5,088,796. In the year the mill treated 1,662,534 tons of ore and recovered bullion worth $19,125,030. Ore reserves are given as 9,641,937 tons grading 0·39 oz. of gold per ton. The No. 4 internal shaft reached its 6,022-ft. objective during the year.

Sudbury.—An Interim report to shareholders of the Associated Arcadia Nickel Corporation states that the company has received an offer to purchase the concentrates from its nickel-copper mine situated on the Worthington Offset. Meanwhile the mine is being kept unwatered and for the past month the equipment has been examined and in the event of the acceptance of an offer it has been estimated that the property could be brought into production within 90–120 days. The ore indicated down to the 950-ft. level is estimated to yield 10,000,000 lb of nickel and 12,000,000 lb. of copper, with substantial values in precious metals.

Manitoba.—The operations of Sherritt Gordon Mines in 1959 resulted in a profit of $2,370,320. In the year 988,541 tons of ore was mined at Lynn Lake, the ore reserves at December 31 being estimated as 14,158,000 tons averaging 0·96% nickel and 0·54% copper.

The Hudson Bay Mining and Smelting Company reports net earnings of $9,904,613 for 1959, metals produced in the year being valued at $45,943,750. Total ore reserves in the Flin Flon and Snow Lake areas totalled 17,457,000 tons at the end of the year.

Quebec.—In the first two months of the current year the output of gold from Quebec Mines totalled 169,738 oz., the February contribution being 84,790 oz. The corresponding silver figures are 696,496 oz. and 348,948 oz. Shipments of asbestos in February amounted to 61,914 tons, making a total of 121,661 tons for the two-month period.

At September 30 last the ore reserves of New Calumet Mines were estimated as 225,925 tons averaging 7·99% zinc and 2% lead, with 4·45 oz. of silver and 0·019 oz. of gold per ton. Recently good developments at the 1,675-ft. level were reported, a body of good-grade ore 25 ft. in thickness grading 15% zinc and 6% lead, with 12 oz. of silver and 70 cents in gold per ton. The 1,800-ft. level is being extended to cut any downward extension of the new find.

It is reported that Coniagas Mines is to bring its property at Bachelor Lake into production at a rate of 350 tons a day. The ore reserves are estimated to be 460,000 tons averaging 15·7% zinc and 1·04% lead, with 8·77 oz. of silver per ton. The plant should be ready in the Spring of next year.

The earnings of Noranda Mines in 1959 are reported as $11,433,171, up 21% on those for the previous year. The copper output for the year is given as 270,948,943 lb.

The Wabush Iron Ore Company, developing with the Iron Ore Company of Canada in the Carol-Wabash Lakes area of Labrador, has a pilot plant nearing construction, but the main plant, with a capacity of 4,500,000 tons of iron concentrates a year, is not expected to be in operation until 1964.

AUSTRALIA

June 20.

Oil.—The Bureau of Mineral Resources has reported on the prospects of oil discovery in Australia. The report states that oil and gas discoveries have confirmed the opinion of geologists that petroleum may occur in useful quantities in Australia, new Guinea, and Papua. Two promising oil discoveries have been made, the report states, one at Rough Range, Western Australia, and the other at Puri, Papua, while large gas discoveries have also been made at Kuru and Barikewa, Papua. These are considered important pointers which could lead to the location of commercial accumulations of oil. Search rights are now held by 69 oil exploration companies over an area of 1,700,000 sq. miles in Australia and Papua and a wedge of petroliferous sediments has been discovered below Cape Range which offers prospect of a useful accumulation of oil in this region. These possibilities are amplified in the opinion of the Bureau by indications of contemporaneous structural relief in the Western Australian basins, suggesting petroleum accumulations above the basement ridges. In Papua continued exploration in the area of the gas and oil discoveries could be expected to give continued success. In Queensland there was plenty of promise in the large number of oil and gas shows in water and gas bores spaced widely over the State.

No single area of Australia and Papua has been thoroughly tested, although some have been shown to be on lithology and structure unlikely to contain large accumulations of petroleum. The first 10 likely areas are: West side of the Aure trough, Papua; Rough Range, Carnarvon Basin; East side of the Aure trough; Broome Ridge, Canning Basin; Ajana-Wandagee Ridge; Northern hinge of the New Guinea Basin; Queensland coastal basins; Georgina Basin, Queensland. In Victoria the Gippsland and Murray basins are ranked after the preceding group. Although not apparently mentioned in the Bureau report significant flows of gas have been met in the Camden district of New South Wales, while the most recent discovery of petroliferous gas was made at Port Campbell, Victoria, and considerable importance was attached to it. A new well is to be drilled about 1 mile from the site of the discovery.

New Zealand.—Plans for a steel industry, in New Zealand are taking shape. A company, Pacific Steel, Ltd., was formed with a capital of £50,000, which is now to be increased to £1,650,000. A site is being prepared for a merchant bar steel mill near Auckland and the erection of an electric furnace and rolling mill is to be commenced shortly. It is expected to start production by the end of 1961.

A large part of the capital is held overseas, but the major part has been subscribed in New Zealand.

The factor of power which bulks largely in the aluminium project based on the Weipa bauxite deposits in Queensland has directed attention to the power resources of New Zealand and to other industrial facilities. The Dominion's power potential lies in hydro-electricity and in coal and these two avenues, particularly hydro-electricity, are being very closely examined in their bearing on the future aluminium industry. Other competing power sources are the black coal deposits of eastern central Queensland, centring on the Blair Athol coal deposit with its 60 ft. of black coal of 11,500 B.Th.U. lying under 40 ft. of overburden and the hydro-electric potential of southern Papua. Decision of the cheapest and most satisfactory location of power means decision as to the site of the aluminium smelter and the headquarters of the new industry. The New Zealand advocates visualize a possible production of aluminium of 250,000 tons per annum worth £A60,000,000. Southland, New Zealand, is regarded as probably the only place in the world where both cheap hydro-electricity and cheap coal are readily available. The region has established deep-water facilities, ample flat land, a harbour town, and a neighbouring provincial city.

Export of Iron Ore.—Strong pressure is being brought on the Commonwealth Government for the removal of the ban on the export of iron ore. The State of Western Australia has been active in the case because even a limited export from one or more of the occurrences within the State would mean useful revenue. The State Government has been drilling certain deposits and has gone so far as to consider mining contracts in anticipation of the lifting of the embargo. A survey of resources by the Bureau of Mineral Resources is stated to have disclosed Australian ore reserves at a tonnage considerably higher than had been previously supposed. Although work has been done on few of the occurrences the economics of many are bound up in transport costs, others are not large and could be worked only as contributors to a central works, or to an export project. It is considered that the case for removal of the embargo will be considerably strengthened by the report. Opinion is that the Commonwealth policy has been over-cautious and that the ban is not justified, but Australian ore reserves, although substantial and recently increased, are not excessive and there has been a recent substantial rise in the demand for steel.

The problem of removing or modifying the export ban needs very serious consideration to ensure that the future of the steel industry is not prejudiced by the opportunities of the present. The proposal under consideration is to permit export up to 50% of any iron deposits discovered in the future ; to limit these exports to some total tonnage to be reviewed from year to year and to forbid the export of ore from existing proved reserves. It is contended that limited export would tend to develop some States, particularly Western Australia, and will stimulate prospecting for new ore occurrences. It is also contended that Australia has mined some 50,000,000 tons of iron ore since 1939, but known reserves are now greater than they were at that date, while there is a number of large deposits, notably in Western Australia and Queensland, that have not yet been included in tested and proved reserves. There is some doubt whether ore occurrences outside those held by the Broken Hill Proprietary Company are of sufficient size to warrant the establishment of another large steel producing enterprise.

Preliminary work may be expected on the Broken Hill Proprietary Co.'s ferro-alloy plant to be built at Bell Bay, following a recent inspection of the site by the chairman of directors, the chief general manager, and the manager of the Newcastle ferro-alloy plant. A power sub-station is to be built on the site. When the factory is in production Australia will be almost self-sufficient in high-carbon ferro-manganese. The new industry is to be known as the Tasmanian Electro-Metallurgical Co. Pty., Ltd., and will be a wholly-owned subsidiary of Broken Hill Proprietary. The works will cost £A1,660,000 and are expected to be producing in 1962. Electrokemisk of Norway is to undertake the design, engineering, and supply of specialized furnace and auxiliary equipment and assist in the supervision of plant erection and the training of operators. The furnace will be a totally enclosed rotating unit rated at 13,200 kVA and will be the largest of its type in the world ; it will be of the most modern design and will incorporate fume cleaning plant of a type proved overseas.

Tasmania.—One of Tasmania's famous tin mines was the Briseis alluvial mine at Derby, a deep lead lying under basalt overburden. Depth of the open-cut workings approximated 350 ft. and in working the old stream channel the Ringarooma River was diverted three times. Ultimately values became unpayable, as the lead was followed down-stream. The basalt overburden was undercut by nozzles, broken to suitable size, and sluiced to the dump. Work is about to be resumed at the neighbouring Valley mine, using water from the Briseis Company's Cascade dam and the extensive system of races feeding it. The ground at the Valley mine is stated to be worth 0·5 lb. tin oxide per ton.

Future ownership of the Bell Bay, Tasmania, aluminium works, of the Australian Aluminium Production Commission, partners in which are the Commonwealth Government and the Tasmanian State Government, is still indefinite. The Commonwealth Government is desirous of selling its interest ; the Tasmanian Government is not able to undertake the purchase of the share and the proposal for sale to private enterprise has met political opposition. It has been reported that the British Aluminium Company which owns a half interest in Comalco, the operating company holding the Weipa bauxite deposits, the other half interest being held by Consolidated Zinc, is likely to purchase the Commonwealth's interest. In that event the early use of Weipa bauxite at Bell Bay would be likely.

Prospecting.—Consolidated Zinc has been very active in prospecting in Australia. The latest direction for the company's activities is Mount Morgan, Queensland, where an authority to prospect has been secured covering 440 sq. miles in the vicinity of Mount Morgan and Rockhampton. The area will be investigated by Consolidated Zinc in conjunction with Mount Morgan, Ltd., which has very extensive and valuable knowledge of the locality.

Custom Plant.—There is a proposal to establish a customs ore treatment plant at Lithgow, New South Wales—its purpose to handle lead, zinc, silver, and copper ores. While there are many small abandoned mines that could supply ore to such a plant the organization of these mines to a productive condition would be a matter of time and money

and it is doubtful whether, at present market prices and general conditions, their operation would be sufficiently attractive to ensure a regular supply of ore to the works.

Copper.—Australia is steadily returning to the position of an important copper-producing country and it is forecast that by the end of this year output of copper will reach 100,000 tons, the first time this tonnage has been reached for many years.

Coal.—The growing export trade in coal is directing attention to improvement in that trade and the need to control and reduce costs to meet competition. It is considered that a heavy handicap in this trade is inadequate port facilities and to remedy this position equipment at Newcastle, Port Kembla, and Balmain, must be improved and expenditure involved will approximate £A6,000,000. A loading rate of 2,000 tons of coal per hour must be provided. The coalfields of New South Wales are able to meet the demand for export coal, but full advantage of the rapidly improving export position cannot be taken until shipping conditions are modernized and expanded on a scale to keep pace with mine production.

Gold in Western Australia.—Lake View and Star was first registered on May 10, 1910, and to mark the 50th anniversary all employees on May 10 this year received an unexpected bonus of £5 in their pay envelopes.

In the MAGAZINE for April last it was noted that continuous pumping operations at Black Lake, Quebec, by the dredge *Fleur de Lis* removed 75,000 million gallons of water. The Goldfields Water Supply Scheme of Western Australia which from 1903 has pumped water to Coolgardie and Kalgoorlie from Mundaring Reservoir (only 20 miles away from Perth), has handled only a trifle more water in its (nearly) 60 years of existence—the amount being about 80,000 million gallons.

A new "find" of gold by natives has been reported from 20 miles north-east of Lenora, several loose stones (or "floaters") having been picked up during sheep-mustering. Some stone was broken up ("dollied") to yield about £A100. Representatives of the Native Affairs Department are said to be "watching to protect the interests of natives." The find is in the area of the once-famous or even fabulous Mertons Reward mine of 1899-1900 and of Waitekauri a little to the east. The well-known Sons of Gwalia is at Leonora and has been worked since 1896.

FAR EAST

June 15.

Malayan Tin Industry.—Mr. P. A. Delme-Radcliffe, the outgoing president of the F.M.S. Chamber of Mines, said in Ipoh that for years the mining industry had protested against the export duty on tin ore, a tax regarded as excessively burdensome. At the Chamber's annual meeting he said: "To tax a primary producer on his product tends to put him out of business—or to prevent him starting," while "taxation on sources of power also raises mining costs, which a miner cannot pass on—as other industries can and do—to the consumer. Marginal producers, therefore, can only go out of business." Loss of employment opportunities when marginal mines went out of production, he said, would be especially serious in Malaya because of the rapidly increasing population. Mines which sought to restart operations, or new ones which sought to open up, should not be discouraged by "inappropriate taxation." Mr. Delme-Radcliffe said that at the beginning of tin restriction in January, 1958, there were 76 dredges and 573 gravel pump mines operating. In March this year the figures were 52 dredges and 425 gravel pump mines. "We are by no means back to where we were before," he added. How long the industry would take to recover, and indeed whether total recovery would take place, depended on the economic climate both in Malaya and abroad. On the question of land tenure he said that where agricultural lands were converted to mining there was at present no guarantee that after they had been worked out the title holders would be able to repossess their land. A right to reconvert to agricultural title might induce the temporary release of some areas of land that would otherwise never be mined.

The outgoing president also said that the Geological Survey continued to be a source of information to the industry. For that reason he would like to ask again that the results obtained from the field work carried out by the department be published at the earliest possible date after completion.

Tin-Ore Smelting.—It has been announced that Indonesia has decided to ship all its tin ore in future to the Straits Trading Company's works at Butterworth, Malaya, for smelting. This decision has been taken on the recommendation of an Indonesian fact-finding mission which visited Penang a few months ago. The first Indonesian shipment, of 511 tons, arrived in Penang recently from Tanjong Pandang, Billiton Island, by the British vessel *Eastern Phoenix*.

Mr. I. Hatta, head of the trade section of the Indonesian Consulate, estimated that under the new arrangement average amounts of "at least 1,000 tons a month" would be sent to Butterworth for smelting and said that he had been informed that more than 4,000 tons of accumulated ore was waiting to be shipped to Penang from Billiton.

New Iron Ore Outlet.—A nearer outlet on the west coast of Malaya has started being used for shipping ore from an iron mine in Perak State. Hitherto mines there have had to send their ore all the way up to Prai for shipment. The new port is Damar Laut, where, to facilitate loading of ore into freighters, Perak Iron Mining Company has constructed a (Malayan) $1,500,000 conveyor-belt system, running on a 1,200-ft. long jetty from the shore into the Dindings River. The first shipment was of about 6,000 tons of ore which was loaded into a Japanese freighter, which moved up the river to about half a mile from the jetty. The ore was from the company's new mine in the Ipoh area, which began operation in April and is producing about 1,000 tons a day. During the course of a few weeks a stockpile of 13,000 tons of ore was built up at Damar Laut in preparation for shipping.

Steel.—Indonesia's steel industry will benefit from a part of the long-term credit equal to about £88,000,000 which Russia has agreed to provide. The agreement specifically mentioned that provision had been made for the design and construction of steel foundries, steelworks, chemical and other plants, textile mills, and other industrial establishments. The credit would carry 2½% interest and

the loan can be repaid in pounds sterling, other readily convertible currency, or in goods.

A steel plant being planned for Formosa will cost about US$50,000,000 and turn out some 160,000 tons of steel annually, according to a report from Taipeh. Such a plant would enable Formosa to save US$10,000,000 a year in foreign exchange, it is calculated. If negotiations now going on are completed satisfactorily Tang Eng Iron Works and Taiwan Aluminium Corporation, two of the largest privately-owned enterprises in Formosa, plan to set up a thermal power station to supply the new steel plant with electricity.

A steel foundry is expected to be set up shortly at Chittaranjan, India, in collaboration with a British firm. This will be the third foundry to be established there, the two others being pig-iron and brass foundries. The new plant is planned to have an initial production of 7,000 tons annually and intended to meet the requirements of the railways.

Peat Project in Pakistan.—The Pakistan Industrial Development Corporation has started experimental production of peat at Faridpur in East Pakistan. It has been decided to produce for the present 2,000 tons of peat by hand-digging and to use it in firing boilers of various power stations and steamers and in burning bricks. Investigations for exploiting peat deposits at Khulna in East Pakistan have also been finalized. Experts from Ireland have been advising the corporation about this matter.

SOUTHERN AFRICA

June 25.

General.—The Prime Minister recently summarized the Government's plans for the establishment of industries on the fringes of proposed Bantustan zones. Decentralization of industry within the Union was becoming urgent because of population growth in the main urban areas and some of the future potential industrial areas are situated in the immediate vicinity of the proposed Bantustans, especially on the watersheds between the eastern escarpment and the sea. The Prime Minister defined the Bantustan border areas as those located not further than about 130 miles from the Bantustan borders and 60 such areas have been investigated in respect of those industries which by reason of required raw materials are highly localized. Of the 60 centres about 17 are possible industrial zones, but the whole programme of developing the border areas can su ceed only in a climate of general industrial development and new industry, he said, should be promoted in the border areas rather than in the existing industrial areas. A permanent committee under a chairman appointed by the Cabinet is to be established, representative of the Departments of Labour, Finance, Commerce and Industry, Bantu Administration and Development, the Railways, and the State-Sponsored Industrial Development Corporation. It will pass on information to interested parties about conditions of production in the border areas, while incentives and concessions to industries promoting establishment in the areas will be considered.

Five of the country's major organized mining, industrial, and commercial institutions—Dei Afrikaanse Handelsinstituut; the Association of Chambers of Commerce of South Africa; the South African Federated Chamber of Industries; the Steel and Engineering Industries Federation of South Africa, and the Transvaal and Orange Free State Chamber of Mines—recently combined in making certain recommendations to the Government in a attempt to ease the prevailing tension and state of emergency. Conceding that agitators and enemies of the State were at work, the representatives of the above institutions nevertheless pointed to the following sources of genuine grievances: The pass laws; influx control regulations; the liquor laws applicable to the Bantu, and curfew regulations. It was observed that the settled urban Bantu population should be treated differently from Bantu in the Reserves; that there is now a wide diversity among the Bantu in class, education, and social standards, and that unrestricted influx of rural Bantu into urban areas should be avoided. The long-service urban Bantu should be privileged *vis-à-vis* the migrant-type and right of transfer from employment should be liberalized with safeguards. The Bantu himself should contribute to administering influx-control regulations and rights of naturalization should be granted to long-service urban foreign Bantu. The employer should be accorded more responsibility in matters of influx-control regulations. The recommendations of the institutions represent experience as employers of the Bantu and a common view.

Mining Development.—The exploration programme of the Anglo American Corporation of South Africa extending from the Union to Tanganyika has yielded encouraging results in places, but has not yet located any important ore deposits. In the Ventersdorp area of the Western Transvaal drilling is to continue into the second half of 1960. The geological and metallurgical investigation of the high-grade iron-ore deposit at Bomvu Ridge near Mbabane, Swaziland, has been completed and is being followed up by examination of the physical condition of the ore. In the Rhodesias and Nyasaland areas of special mineral interest remained under investigation; additionally options and prospecting rights have been acquired over several areas of possible economic interest. In Northern Rhodesia the initial aerial geological survey of the 120,000 square miles of exclusive prospecting rights of the associated Chartered Exploration, Ltd., has been completed and ground geophysical and geochemical prospecting is being advanced in selected areas. A new company, Lunga Exploration, Ltd., assumed prospecting and option rights over a portion of the holdings of Kasempa Minerals, Ltd., in the Lunga area. In Tanganyika the four-stage programme of the associated Western Rift Exploration Co., Ltd., in its concession area of 34,000 sq. miles is approaching its final stages.

The Union Corporation has reported that recent statistical returns of the gold-mining industry serve to remind that great resources of gold still await development in the Union over many years ahead. The Corporation continues to seek new economic mineral deposits and to investigate business opportunities for profitable investment. Further exploratory operations have been conducted in the Kinross area outside the Winkelhaak, Bracken, and Leslie lease areas, with much of this effort advanced to the north-west of the Winkelhaak mine; they are being continued. Prospecting ventures for both gold and base metals have also been undertaken elsewhere than in the Kinross area. In the technological field—especially in prospecting, mining, and milling—research has resulted in adapting the

run-of-mine ore-milling technique to gold metallurgical practice at the Winkelhaak mine, which technique will also be applied in the Bracken and Leslie gold plants. The group has also developed a new small-diameter bore-hole survey instrument.[1]

Trade.—Over the first four months of 1960 imports increased to £184,342,000 from the corresponding 1959 figure of £163,502,000; exports improved to £148,297,000 from £133,387,000 excluding gold sales, which declined to £77,029,000 from the corresponding 1959 figure of £84,360,000. Again excluding the gold sales the adverse trade balance in the 1960 period increased to £36,045,000 from the 1959 figure of £30,115,000.

Blair Hoists.—Zandpan Gold Mining is using a Blair stage hoist for the sinking stage and a 200-h.p. hoist to operate the brattice-wall stage in sinking its No. 1 shaft in the south-central section of its lease area—that is, a short distance north of the southern common boundary with the Vaal Reefs and Western Reefs properties. Water-bearing fissures requiring cementation are retarding sinking operations to some extent, but nevertheless a satisfactory rate is being maintained. Plans have already been formulated for the sinking in due course of a second shaft to the north-east of No. 1.

Both Buffelsfontein and President Brand are installing a Blair multi-rope, multi-layer hoist. The advantages claimed for the new hoist are :—

(1) The use of smaller-diameter ropes and therefore smaller-diameter drums, which in turn require lighter mechanical equipment, smaller-diameter headframe sheave wheels, higher drum speeds, and higher-speed motors.

(2) Problems in the use of ropes of 2 in. and greater diameter ropes are eliminated at the rope cross-over.

(3) The reduction in the safety factor in the use of multi-ropes considerably increases the pay load.

(4) Either two or four ropes may be used in supporting the load.

In a single-rope hoist an end load of 21·5 tons at 6,000 ft. would require a rope diameter of 2·25 in. to conform with a factor of safety of 5. To satisfy these conditions the drum diameter should be 18·25 ft. and the r.p.m. 52 for a rope speed of 3,000 f.p.m. This drum r.p.m. would require a relatively large reduction from the motor speed. Under the same conditions the two-rope hoist using 1½-in. rope would require only a 12-ft. diameter drum for an end load of 22·57 tons. For a rope speed of 3,000 f.p.m. the drum speed would be 80 r.p.m. involving a smaller reduction from the motor speed. A multi-motor drive may be installed. If necessary the Blair hoist could be converted to use as two single-drum winders, for use in sinking operations, and readily restored to multi-rope hoisting for its permanent duty. An equalizing pulley fitted above the load ensures an equalization of the load in each of the supporting ropes.

Diamonds.—De Beers Consolidated is considering the re-opening of the old De Beers or Kimberley Mine (the Big Hole) on the outskirts of Kimberley. It was last operated 46 years ago. Workings had reached a depth of about 3,500 ft. at the time of the suspension of operations.

Transvaal.—It appears that in the ultra-deep levels of City Deep the longwall system of stoping will probably be adopted, involving the mining of all the reef exposed whether payable or not. Recent development values have been reported on this basis—namely, that these values are the average of both the payable and unpayable footages.

Crown Mines is to extend its ultra-deep development below a major dyke zone, as results to-date have have not been wholly encouraging and it is therefore necessary to obtain more conclusive disclosures before an accurate assessment of the potential of the ultra-deep zone can be made.

Modderfontein B owns about 8,233 acres of freehold, of which about 5,151 acres are subject to mining rights held by neighbouring mines and otherwise encumbered by dumps, dams, etc. The balance is proclaimed land, but it is suitable for disposal and is potentially valuable. However, this freehold is subject to zoning under the Group Areas Act, in regard to which zoning no final decision has yet been reached by the Authorities. This decision is still awaited.

In order to facilitate an earlier start of production by Leslie Gold Mines, possibly about six months ahead of the previous schedule—*i.e.* by about the end of 1962 or a little later—the 14-ft. diameter ventilation component of the twin-shaft system is to be sunk initially to a depth of about 2,050 ft. instead of 3,100 ft. This will facilitate an earlier start of reef development in the shaft area, where the reef depth is about 1,500 ft. The main shaft component will be sunk, as planned, to 3,100 ft.

With its Main Reef horizon considered virtually fully developed, and with increased Kimberley Reef development yielding only moderate gold values to an extent contributing no tonnages to the ore reserves and no significant tonnages to mill, a position which will continue unless better development results are disclosed, East Geduld Mines can be considered as well past its climacteric although it still has a substantial profitable life ahead of it.

Grootvlei Proprietary, which has already substantially expanded Kimberley Reef development along a small section of the western portion of its southern boundary, is advancing operations to effect a connexion between the Nos. 3 and 4 shaft workings in the south-western section preparatory to a marked planned extension of development on this horizon. Payable Kimberley Reef tonnage has not yet been included in the ore-reserve tonnage.

Winkelhaak Mines has been granted an additional lease over 245 claims on its south-western boundary, thereby increasing its mining area to 5,363 claims. Extensions to the gold plant increasing the capacity to 90,000-110,000 tons a month have been virtually completed.

The Union Corporation has registered another subsidiary company—Willow Mines, Ltd.—with a registered capital of £50,000. The name is in line with those subsidiaries formed to conduct exploration in the Kinross area. A possible assumption is therefore that exploration in the same area has been and is being extended in that area.

Orange Free State.—Exploration by St. Helena Gold Mines, as distinct from development proper, has recently been confined to a prospect area adjoining the northern portion of the western boundary and to a bore-hole being drilled south of the workings in the sub-outcrop zone. In the former values of 244 in.-dwt have been disclosed. Results from the bore-hole are not yet available, but, while apparently primarily projected for planning the extension of operations southwards, they should also throw some light on what may be expected from the company's holdings in the Ongegund Section south of the southern boundary of the lease area. Only

[1] See THE MINING MAGAZINE, February, 1960, p. 67.

limited reef stoping has so far been advanced in the high-grade No. 2 Shaft area, where operations, while disclosing satisfactorily high values, have been impeded by severe faulting.

The trend of development in the lease area of Virginia (O.F.S.) Gold Mining in the recent past has been to open up the south-western section, adjoining the common boundary with the Merriespruit lease area. This may be preparatory to the conclusion of negotiations between the two companies whereby the Virginia mine would extend development southwards into the Merriespruit area and mine and treat ore from the latter on a royalty basis.

Closely following the completion of sinking the No. 3 Shaft to its final depth of about 5,850 ft. in the Riebeeck section of Loraine Gold Mines, the twin-haulage driven from the No. 2 Shaft has holed through to the No. 3 ; it had been driven something like four miles. Conditions of ventilation and haulage have now been provided with the connexion effected and this will facilitate a marked expansion of the development rate on the multi-banded Elsburg Reefs from cross-cuts taken from the twin haulage. Stoping of Elsburg ore is expected to be initiated by about the year-end. An accurate assessment of the average bore-hole grade of the Elsburg Reefs is not possible at this stage but an indicated grade range would be about 500 to 700 in.-dwt over, say, 46 in.

Cape Province and Natal.—Associated Manganese Mines of South Africa, which early this year commissioned a new manganese mine in the Kuruman-Hay area of the north-western Cape, exported 173,758 short tons of manganese ore and sold to domestic consumers 37,060 tons in 1959. Exploratory operations are being continued. Production and marketing of iron ore have now been initiated and prospects of establishing an export market appear favourable, the improved rail transport position from the north-western Cape to the export ports contributing to this new development. The subsidiary, Feralloys, Ltd., which commissioned its ferro-manganese works at Cato Ridge in Natal in October, 1959, has overcome initial teething troubles and has brought the plant to satisfactory operation.

Central African Federation.—The Copperbelt Technical Foundation, representative of the Federal Government, the Northern Rhodesian Government, and the Copperbelt mining companies, has come to the conclusion that the provision of technical education on the Copperbelt should be considered not in isolation, but as a regional matter, against the broader background of the needs of the whole territory. Accordingly it has been agreed to survey these comprehensive needs, the costs of which will be defrayed by the copper-mining companies. A committee has been selected for this purpose consisting of Sir David Lindsay Keir—Master of Balliol College—as chairman (who is also chairman of the Overseas Colleges of Arts, Science, and Technology), Mr. F. Bray, adviser to the Federal Government on technical education, and Mr. J. C. Jones, adviser to the U.K. Secretary of State for the Colonies on the same subject, while Mr. A. L. Pons will be secretary to the committee. Preliminary enquiries are in progress.

Trade Notes

Brief descriptions of developments of interest to the mining engineer

Rig for Long-Hole Stoping

The development in South Africa of a new drilling unit—the Holman " Thruster " Rig—for use as a long-hole stope drilling machine is announced by **Holman Bros. (Proprietary), Ltd.,** of Johannesburg, the South African subsidiary company of Holman Bros., Ltd., of Camborne. The new rig has been developed to meet the increasing need in African mines for an extremely accurate, compact, and easily-portable machine for use in limited space and headroom, particularly in flat and narrow stopes. For the purpose a completely new feed system has been discovered. This comprises a cylinder and piston assembly similar to the retractable air leg. The cylinder is mounted horizontally directly behind the drill on a slide rail and the feed pressure is controlled by a twist-grip throttle mounted at the end of the piston rod near the back end of the drill. The slide rail assembly is supported on two tubular steel cross members which are in turn supported on four adjustable screw-end jack bars. The piston rod is fitted with two air passages, one to provide air behind the piston for forward movement and the other which vents in front of the piston for its retraction. A valve controls the simultaneous change-over of air to the front or rear of the piston. The cylinder body is also designed to move forward and backward in a slide during the advance feed and drill extraction operations.

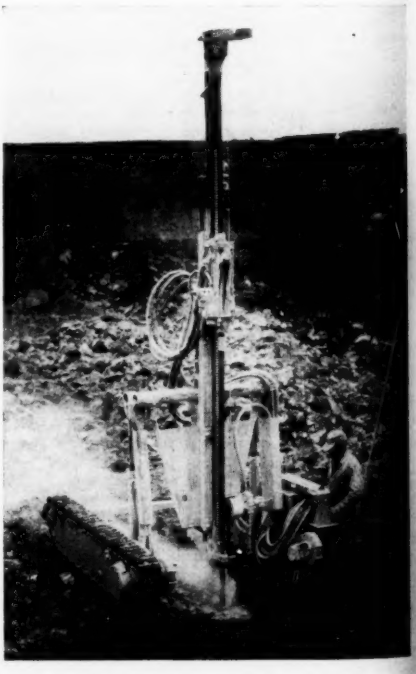
The machine is designed to be dismantled easily for movement from face to face and also to allow easy removal for maintenance,

Thruster Drill-Rig.

etc. The unit can be assembled without the use of a spanner while the heaviest single part is the rock-drill. An important feature of the Thruster is that it is also suitable for drilling foot-wall holes when placed in an underslung position.

Self-Propelled Drill

The Joy Manufacturing Company, of Pittsburgh, whose British associates are **Joy-Sullivan, Ltd.,** of Cappielow, Greenock, have made available some particulars of the TDM Trac-Drill, a ruggedly-built, self-propelled machine, which will cover the roughest terrain and rapidly spot and bottom holes up to 4 in. in diameter and 40 ft. deep. The Trac-Drill will drill at practically any angle and because of its air-operated, piston-type hydraulic pump all movements are fast and sure. The Joy air motors for tramming each develop 11·5 h.p. which give the TDM excellent tramming speed and enough power to tow a 900-c.f.m. rotary portable compressor up a 10% grade. Heavy-duty crawlers with 8-in. pads and a long ground contact (84 in.) give positive stability regardless of ground conditions, while the knee action of the crawler system permits quick set up for true vertical holes in uneven terrain. The machine carries the Joy 450-DR dual-rotation drill which has independent rotation for coupling and uncoupling steels and for boosting normal rifle bar rotation. This new drill is a 4½-in. machine which it is claimed can drill 3½-in. diameter holes to a depth of 40 ft., the dual rotation being provided by a vane-type air motor geared to the chuck. It has forced-feed lubrication and replaceable bushings at all major wearing points.



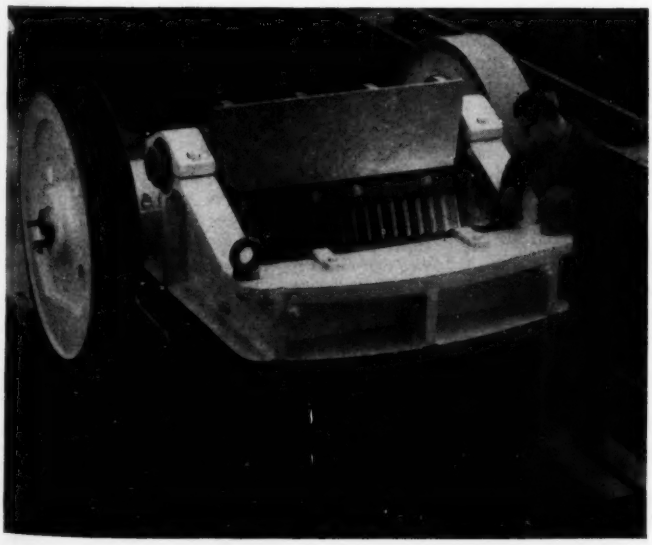
T.D.M. Trac-Drill.

Trac-Drill in Action.

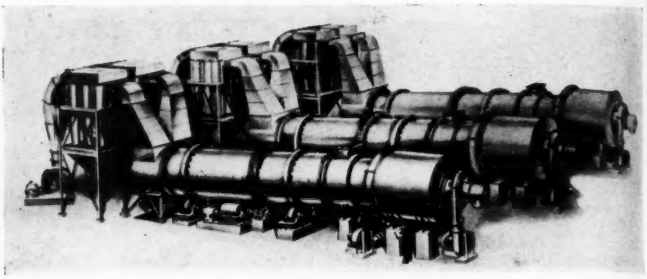
A powerful air-motor-driven chain feed provides plenty of pressure for drilling and power for pulling strings of steel. Extra large air tube ($\frac{9}{16}$ in.) extends into the drill steel shank and the dual rotation couples or uncouples drill steel without hammering action. Stuck steels, it is claimed, are practically eliminated.

Wide-Jaw Crushers

Blake crushers with extra-wide jaws are made at the Fraser and Chalmers Engineering Works of the **General Electric Co., Ltd.,** of England, in two sizes—namely, 40 in. by 16 in. and 50 in. by 16 in. Such machines bridge the gap between the smaller range of crushers and the larger true primary breaker. The wide-jaw crushers are specifically designed for reducing hard or tough ore which is not more than 12 in. in size to 3-in. to 4-in. ring at the rate of 50 tons to 100 tons per hour. One such crusher (50 in. by 16 in.) has recently been installed at the Mosaboni mine of the Indian Copper Corporation, Ltd., in Bihar State. The feed rate, 100 tons per hour, could not be handled economically in a single primary machine in the normal range. The manufacturers state that these crushers with extra-wide jaws satisfactorily cover the intermediate range of 50 tons to 100 tons per hour crushing, being cheaper both in first cost and in running expenses than any other crusher or combination of crushers suitable for hard ore or rock. They are of all-welded construction throughout and have roller bearings on the eccentric shaft for both the main frame and the pitman.



50 in. by 16 in. Blake Crusher.



Drying Plant.

Iron Ore Drying Plant

It is announced that **Head Wrightson Stockton Forge, Ltd.,** a subsidiary of Head Wrightson and Co., Ltd., is to supply to Richard Thomas and Baldwins, Ltd., six rotary dryers for an iron-ore drying plant costing approximately £240,000. Three of these machines, each of which measures 45 ft. long by 10 ft. in diameter, are to be installed at the Redbourne Works and three at the Spencer Works. They are each capable of handling a weekly output of 21,350 tons of ore from 0 in. to 2½ in. in size. The rotary dryers are arranged in parallel flow and each has a rated capacity of 50 tons per hour when drying from 20% moisture down to 9%.

It is believed that these machines will be the most highly instrumented of their kind in this country. The maximum temperature of dried ore is approximately 200° F. with the maximum temperature of exhaust gas, prior to the dust separator, being 210° F. and at the exit from the collectors about 200–205° F. The efficiency of the dust collectors is such that with an inlet dust content of 18–20 g. per cu. ft. of gas the outlet dust content would be no more than 1 g. per cu. ft. The fan is rated at 37,000 cu. ft. per minute at approximately 230° F., against a resistance of 9 in. W.G.

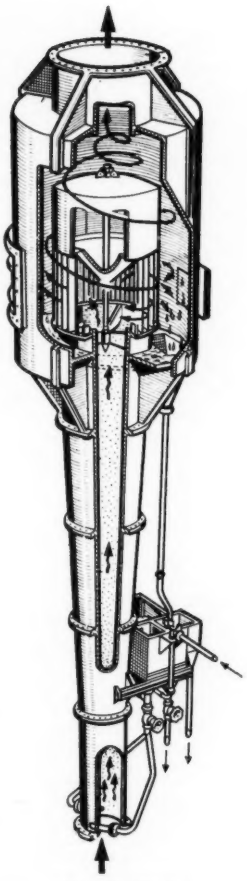
The dryers are fitted with automatic temperature controls, which will ensure a constant entry and exit gas temperature for a variable feed or feed moisture content. Any variation, therefore, will obviously require an increase or decrease in the heat transfer rate so that to maintain the gas entry and exit temperature automatic adjustment is made to the gas primary air valves, linkage, and dilution air valve. These controls will ensure within limits a constant predetermined product moisture content.

For variable gas and air rates the exhaust fan is fitted with a damper control. For optimum conditions this fan should be capable of drawing the waste gas and steam through the system without creating any undue negative pressure at the open feed chute. This control is effected by having the fan damper controlled from pressure points in the vicinity of the feed chute.

Wet Dust Collector

A wet collector developed by **Thermix Industries, Ltd.,** of 143, Maple Road, Surbiton (a member of the Dunford and Elliott engineering group), is now finding useful application in the coal, coke, foundry, and quarrying industries as well as in other fields. It has, for example, been used for drying chlorine, washing nitrous, sulphurous, and ammoniac vapours, and as a pre-filter before a wet electrostatic filter. The machine, known as the "Airmix," is easily adapted for installation as a secondary collector on existing plants.

The Airmix device is a self-induced spray-type vertical venturi wet washer, as illustrated, which separates dirty water from cleaned gases by centrifugal action. The washing water is fed tangentially to the venturi throat by two, three, or four pipes, depending on the size of the collector, the gases flowing through the throat at high speed spreading the water on to the cylindrical surface and carrying it vertically. The great difference in the velocity of the two fluids causes the gas to break up the waves which form on the surface of the water film, thus intimately mixing the dust-laden gas and the water droplets in the fine spray produced. The mixture then enters a tapered diffuser section where its speed is slowed down and the dust particles which have escaped so far are wetted as the dust-laden gas again passes



Air-Mix Unit.

through a cloud of water droplets. Upon reaching the top section of the Airmix the mixture is diverted into a ring of curved vanes which impart a strong rotational motion to separate gases and water by centrifugal action. Any particles still in a dry state are wetted by impingement with the vanes. The dirty water is evacuated by a discharge pipe and the cleaned gases pass out through a chimney.

The unit is constructed of mild steel and is available in a range of standard sizes with capacities from 1,300 c.f.m. to 30,000 c.f.m. For handling larger volumes a number of smaller units can be operated in parallel. A galvanized finish or for certain applications corrosion-resistant linings or special materials such as stainless steel can be supplied.

Personal

T. B. ADKINS, general manager of the Ore Mining Branch of the United Steel Companies, for the past 13 years, retired on June 30 after 56 years' with the company. He is succeeded by D. R. WARD JONES, previously assistant general manager of the Ore Mining Branch.

C. B. ANDERSON is the new president of the Transvaal and Orange Free State Chamber of Mines.

G. L. J. BAILEY has relinquished his position as superintendent of Mond Nickel's Development and Research Laboratory in Birmingham and is to transfer to London to become Manager of Research.

D. H. BATCHELOR, has been appointed manager of Geevor Tin Mines, Ltd., to succeed J. H. BENNETTS, who is retiring.

CHARLES M. BEHRE, Jr., of New York, Professor of Economic Geology at Columbia University, is to represent the Council of Education of the American Institute at the International Geological Congress.

E. J. BRADBURY has succeeded Dr. G. L. J. Bailey as Superintendent of Mond Nickel's Development and Research Laboratory in Birmingham.

G. J. COSLETT has left for Burma.

E. M. DAVEY is returning on leave from Nigeria.

F. A. DAVIS, general manager of North Kalgurlie (1912) has been visiting this country.

JOSEPH L. GILLSON, president of the A.I.M.E. and former president of the American Geological Institute and of the Society of Economic Geologists is to represent the Institute at the International Geological Congress in Copenhagen.

J. R. HEAPS is returning from Ghana.

J. L. KIRKUP is returning from Rhodesia to take up an appointment at the Warren Spring Laboratory.

H. C. KOCH and W. S. FINDLAY have been elected vice-presidents of the Transvaal and Orange Free State Chamber of Mines.

A. W. LEHMAN is here from Chile.

F. D. LEWIS is home from India.

N. W. LITWINOV is home from Ghana.

J. E. A. PATERSON is home from New Caledonia.

L. B. PFEIL has been appointed vice-chairman of the Mond Nickel Co., Ltd.

D. W. PRINGLE, who has been advanced from mine superintendent to general superintendent of the Britannia Division of the Howe Sound Company, succeeds A. G. KIRKLAND who has resigned to become manager of the Canadian operations of the Texas engineering firm of Brown and Root, Inc.

A. M. STARR is now in France.

L. R. VERNEY has been appointed assistant consulting metallurgical engineer to the Rhodesian Selection Trust Group of Companies.

R. J. AGNEW a director of Gold Fields Australian Development and of Lake View and Star, Ltd., for many years manager of the Lake View and Star mine, died in Australia last month.

P. K. GHOSH, director of the Government of India Atomic Minerals Division, was killed in an aeroplane accident in the Himalayan foothills on June 19. Dr. Ghosh had been director of the Division since 1955.

Metal Markets

During June [1]

Copper.—In retrospect June has been an active and interesting month and prices have not stood still for very many days together.[2] One of the most active considerations for the market has been political developments in the Belgian Congo (now the Congo Republic). This chapter is, of course, by no means closed, but at least independence day has been reached without any outbreak of major civil war or other disastrous disturbances which would interfere with copper production in the Katanga. Indeed, this has been a major bull factor in a market which has consistently been disposed to look for the bear point of view. This angle was most in evidence in the early part of the month as a result of a statement by Mr. Harry Oppenheimer, chairman of the Anglo American Group, who referred more pointedly and positively to the fact that major world copper producers not only should but by inference would adjust their output to equate with demand should the latter fall too far behind the former. In the event June has passed without any active signs of the need for such output reduction to be initiated.

Although the American position is still not very bright European demand has been strong and throughout the month spot supplies of copper have tended to be tight, as reflected by the fact that any shapes available outside period contracts have commanded at times useful premiums. Still in bullish vein reference must also be made to a strike of dock workers at Liverpool in the closing days of June, which seriously interfered with arrivals of metal through that port and helped push the cash price on the London Metal Exchange up to quite high levels, which were accompanied by a wide backwardation. On the other side of the picture the economic outlook in the U.K. has taken a noticeable turn for the worse; so far specific evidence of this has been restricted to consumer-goods manufacturers, but there is reason to suppose that difficulty may be more widespread. The trouble has been attributed to the U.K. Government's credit squeeze (continued in an increased Bank Rate in June), but some people see it having deeper roots. Developments during the rest of the summer, therefore, when the economy traditionally slackens off, will be watched with more than usual interest.

U.K. copper consumption in March amounted to 58,678 tons, of which 41,147 tons was refined. Production of primary refined metal in the U.K. in the same month totalled 8,607 tons; production of secondary refined was 7,476 tons. Stocks of refined copper at the end of April amounted to 45,277 tons, against 39,878 tons at the end of March. Blister stocks totalled 14,127 tons, as compared with 12,599 tons the previous month.

Tin.—The feature of the tin scene in June was the announcement from New York of the proposed form of the new Tin Agreement to run from July 1, 1961. It was not in doubt that an agreement of some sort would be devised at this meeting, but the form which it ultimately took was sufficiently removed from earlier guesses to be of interest. The key question of whether either the U.S.A. or the Soviet Union would participate as members was found to be answered in the negative; however, two conspicuous absentees from the consumer side of the current agreement—West Germany and Japan—have both provisionally indicated that they will participate. At this stage, of course, everything is subject to ratification by the relative governments. Of less interest is the fact that Guinea and the United Arab Republic are in, and Israel and Ecuador are out, as consumers.

The size of the Buffer Stock has been reduced from 25,000 to 20,000 tons, which slightly relieves the strain on producing countries' finances; moreover, the Stock Manager can borrow against the tin he holds to buy more tin. Initial composition of the stock will be 12,500 tons metal and 7,500 tons cash equivalent. Interestingly the council may call for export control if the stock holds 10,000 tons of metal or more. There has been no revision of any of the three price ranges established in the present agreement, but even in the latter part of June the market[1] has shown that it can be more volatile once the shadow of Buffer Stock Manager intervention has been removed, as it was, of course, on July 1.

U.K. tin consumption in April totalled 1,774 tons. Production of new metal amounted to 1,645 tons, as compared with 2,743 tons the previous month. Stocks on April 30 were 10,349 tons, against 10,677 tons at the end of March.

Lead.—During June sentiment in lead has had a return to a rather depressed state. Prices too have reverted to the low 70's although they have not yet broken through the £70 per ton level which seems to have become established as a psychological floor for this market in recent months.[1] The trouble is quite simply the basic statistical position, which has obtruded again on the notice of market observers through the obviously unfavourable implications for lead-using industries in the less favourable tone which has developed in the U.K. economic climate. It is now rather a case for the market to hang on until September, when a further meeting of the United Nations Lead and Zinc Study Group will be held and may possibly offer some path out of the wood for this metal.

U.K. stocks at the end of April amounted to 50,363 tons as compared with 41,248 tons at the end of March. Lead production in this country in April totalled 8,099 tons, as compared with 9,522 tons in March. Consumption was 28,148 tons.

Zinc.—With the other markets attracting interest for their various different reasons during June zinc has been somewhat outshone during the month. There has in fact been a dearth of any interesting new developments and prices have stayed closely around the £90 a ton mark for nearby metal.[1] The less cheerful news from various sectors of the consumer goods industry in this country means, of course, no good to zinc in the next few months, but the broad position both in Europe and in the world generally is quite nicely in balance, without the need for any artificial restrictions on supplies.

In April consumption of zinc amounted to 28,069. Stocks totalled 54,491 tons, of which consumers held 20,296 tons. Production amounted to 6,165 tons, as compared with 7,110 tons in March.

Iron and Steel.—The British iron and steel industry still rides the crest of the wave of prosperity, but there are ominous mutterings hinting of a break in the economic weather. The dismissal of workers

[1] Recent prices, pp. 8, 48.
[2] See Table, p. 48.

[1] See table, p. 48.

at Hoover and the cutting of overtime at Vauxhall Motors may be the forerunners of severer conditions in the consumer goods markets. The Government's recent restrictions on hire purchase are already having their effect and the raising of the Bank Rate to 6% may discourage steel consumers from building up stocks, thereby reducing pressure on the mills.

At the moment, however, the effect on steel industry order books has been negligible and works are heavily booked for nearly every product. Indeed, imports of various steel items are rising because home production is inadequate to meet the heavy demand. Steel sheet arrivals in May totalled nearly 64,000 tons, probably the highest monthly figure ever, making over a quarter of a million tons for the first five months of the year. Imports of billets are also increasing and supplies have been bought from Japan, Canada, and Rhodesia, while arrivals of wire rods show an upward trend. Total imports in January to May were over 550,000 tons (against 220,000 tons in the same period of 1959), while exports, which recently have been well below peak levels, totalled 1,500,000 tons (1,125,000 tons).

Iron Ore.—In May the U.K. imported 1,483,345 tons of iron ore, against 863,431 tons a year previously, making 6,816,308 tons for the first five months of 1960 (4,396,248 tons in January–May, 1959).

Aluminium.—Following the I.C.I.-Aluminum Co. of America purchase of Almin, Ltd., and hence International Alloys, Ltd., as reported last month, Aluminium, Ltd., has acquired a share in the secondary aluminium plant operated by the Enfield group. A new company called Alcan Enfield Alloys was formed in mid-June to take over the running of the plant, which has a capacity of 12,000 to 15,000 tons of secondary ingot a year. Its output, which will be marketed in this country by the existing Alcan (U.K.) organization, will be composed chiefly of alloys not hitherto available from Alcan. The company has specialized in LM6, LM10, LM11, and LM22, all of which are made from virgin metal in Canada.

At the beginning of June the Government announced details of reductions in its import duties to be charged on aluminium semis imported from other member countries of the European Free Trade Association. These only came into force on July 1 and it is therefore, of course, too early yet to actually see the effect of the changes. Nevertheless, there have already been some forecasts made as to the extent of likely shifts in the competitiveness of certain countries. With aluminium foil, for example, Western Germany, which has always supplied us with substantial quantities until now, is put at something of a disadvantage as compared with Switzerland, another leading foil supplier. The duty on Swiss foil is now only 16%, whereas that on West German amounts to 20%. Another example is provided by Austria, possibly the most competitive of the other West European fabricators so far as Britain's overseas markets are concerned. It, too, will benefit from the reduced U.K. tariffs and some observers fear that it may be just as competitive in this country as overseas in future.

On the bright side, however, it must not be forgotten that similar reduction in the import duties charged by the other members of the Seven will favour the United Kingdom aluminium industry's exports to those countries just as much as those of her associates.

Antimony.—June was another healthy month for antimony, although a rather featureless one from the point of view of specific new market developments. However, some idea of just how active the U.K. market has been in recent months can be derived from figures published during June by the British Bureau of Non-Ferrous Metal Statistics. According to these figures U.K. consumption of new antimony in April, at 469 tons, brought the figure for the first four months of this year to 1,973 tons, against only 1,474 tons in the same period of 1959. Total consumption of antimony in scrap was also greatly increased at 2,064 tons for the January–April period against 1,594 tons in the first four months of last year. Prices for English regulus 99·6% and 99% remained throughout June at £197 10s. and £190 per ton respectively.

Arsenic.—Arsenic, like antimony, was featureless from the market point of view in June and quotations once again remained at £400 a ton for arsenic metal and £40 to £45 a ton, ex store, for arsenic trioxide.

Bismuth.—Trading in bismuth, which has been largely featureless for many months past, also showed no new developments. One-ton lots of bismuth metal, ex warehouse, continue to be quoted at a nominal figure of 16s. a lb.

Cobalt.—Congolese political developments are, of course, relevant to the cobalt market, but it is too early yet to assess their effect. Meanwhile quotations for open-market metal in this country remained throughout at 12s. a lb. delivered. The U.K. contract quotation was again unaltered at 10s. 9d. a lb. delivered.

Cadmium.—Cadmium prices were also unchanged in June at 10s. 6d. a lb. for U.K. and Empire refined metal sold in 1-cwt. lots and 10s. 6d. to 10s. 9d. a lb. delivered for foreign metal in similar 1-cwt. lots.

Chromium.—Chromium is another metal which has shown few, if any, features of note for a long time past. Quotations throughout the month remained, so far as this country was concerned, at 6s. 11d. to 7s. 4d. a lb.

Tantalum.—Tantalum ore has again been selling at 700s. to 750s. a unit.

Platinum.—The price in this country of U.K. and Empire refined platinum has again remained steady at £30 5s. a troy oz. Open-market material has also been firm in recent weeks at £28 5s. to £28 15s., although consumers were reported to be showing rather less interest in material from this source than in U.K. and Empire material. In America futures trading on June 27 on the New York Mercantile Exchange was larger than for the whole of the first five months of this year and indeed the number of lots sold was higher than on any other single day since futures trading began in 1956. Prices fell by no less than $1·5 per troy oz. but, according to all reports, refiners have tended to play down the importance of this sudden spurt of activity and to insist that there is no fundamental change in the market.

Iridium.—In a continued quiet market the quotation for iridium softened in the latter half of June, the new range for sponge and powder being a nominal £22 to £23 15s. per troy oz. against £23 to £26 15s. previously.

Palladim.—Palladium was again quoted at £8 10s. to £9 7s. 6d. per troy oz.

Osmium.—The quoted price of osmium eased in June from a nominal £22 to £25 a troy oz. to a nominal £20 to £25.

Tellurium.—After the recent increases in both U.S. and U.K. prices for tellurium (reported last

month) the market has settled down at these new levels. So far as this country is concerned the price for tellurium lump and powder is quite firmly established at the moment at 25s. a lb., while tellurium sticks can be had in small quantities at 40s. a lb.

Tungsten.—After a very active start—despite the Whitsun holiday total turnover in the first week of the month was as high as 150 tons at prices nearly all above 160s. a long ton unit—the tungsten ore market took on a very much duller tone about mid-way through June. From 158s. 6d. to 163s. a unit the quoted range fell a full 2s. 6d. overnight, but subsequently it recovered somewhat. By the month-end it was back up to 157s. to 162s. although only very little business was being done.

Nickel.—During the latter part of June and, indeed, into the beginning of July the United States General Services Administration was holding talks with a Cuban Government delegation in Washington about the future of the U.S. Government's Nicaro plant. At the time of writing the position is still far from certain, but so far as can be gauged even a favourable outcome for the G.S.A. will be of little, if any, significance so far as the future of operations at Freeport's Moa Bay installation is concerned. However, as the big Inco project in Manitoba proceeds towards completion, the accent is again transferring from supplies to outlets, as this development will mean a substantial increase in world capacity. Refined nickel remains quoted at £600 a ton delivered for lots of 1 ton and more.

Chrome Ore.—The chrome-ore market has been generally subdued in recent weeks, but towards the end of the month there were reports that Turkish producers were experiencing something of a revival of buying interest from Western Europe. Enquiry was reported for good-grade metallurgical ore in lots from 4,000 to 20,000 tons and offers were said to range from $33·5 to $34 a ton, although it is fair to say even the published quotation for Turkish metallurgical ore—$33·5 a ton f.o.b.—is nominal. Rhodesian metallurgical ore is still quoted at £15 5s. a ton c.i.f.

Molybdenite.—The molybdenite market again showed no new features in June. The price of American Metal Climax material f.o.b. mines remains at 8s. 11d. per lb. of Mo contained. Molybdenite from other sources is still priced at 9s. 3½d. per lb. c.i.f.

Manganese Ore.—Better prospects for manganese ore were forecast by several members of the trade last month. The chairman of the Central Provinces Manganese Ore Company said that not only had his company experienced some growth in demand in recent months but that the domestic Indian market was almost certain to require substantial quantities of ore in future. However, he also foresaw severe competition and warned that profit margins would almost certainly suffer.

The U.S. Commodity Credit Corporation has agreed to take 100,000 tons of Brazilian manganese ore from Amapa for the United States supplemental stockpile in exchange for wheat. Originally, it will be remembered, Amapa ore was to go to the strategic stockpile (from which it could not be sold) under the terms of the agreement whereby the U.S. Government gave financial backing to the project. Now that some has been taken for the supplemental stockpile, however, the way is always open for this quantity to be released on to the market at a later date. C.i.f. prices for 46% to 48% ore remain at 68d. to 73d. per unit of metal contained.

Tin, Copper, Lead and Zinc Prices

Tin, minimum, 99·75% ; Copper, electro ; Lead, minimum 99·75% ; and Zinc, minimum 98% per ton.

Date		Tin				Copper				Lead				Zinc			
		Settlement		3 Months		Spot		3 Months		Spot		3 Months		Spot		3 Months	
		£	s.	£	s.	£	s.	£	s.	£	s.	£	s.	£	s.	£	s.
June	10	790	0	788	5	246	5	241	17½	74	13¾	74	13¼	90	2½	90	1¼
	13	789	0	787	10	246	7½	241	17½	74	11¼	74	13¾	89	17½	89	18¾
	14	789	10	787	5	257	17½	242	12½	72	17½	73	18¾	89	12½	89	18¾
	15	794	0	789	10	250	15	244	17¼	72	17½	74	1¼	89	18¾	90	1¼
	16	797	10	789	10	251	15	245	17½	73	7½	73	16¼	90	5	90	5
	17	798	0	788	15	252	15	246	17½	73	13¾	74	0	90	8¾	90	7½
	20	796	10	789	0	253	15	246	7½	73	16¼	74	6¼	90	8¾	90	2½
	21	797	0	789	5	255	15	246	12½	72	16½	73	6¼	90	6¼	89	18½
	22	798	0	791	15	257	7½	247	12½	72	11¼	73	6½	91	6½	90	6½
	23	797	10	791	10	257	15	247	15	71	16¼	72	6¼	91	3¾	90	2½
	24	796	0	790	15	253	10	244	17½	71	16½	72	16½	91	0	90	1½
	27	798	10	791	15	285	5	245	15	71	12½	72	11¼	90	11¼	89	16½
	28	800	0	792	5	256	5	245	5	70	11¼	71	18¾	90	8¾	89	15
	29	800	0	791	5	249	5	243	5	70	16¼	72	2½	90	12½	89	17½
	30	807	0	795	15	256	15	245	15	71	11¼	72	12½	90	13¾	89	18½
July	1	813	0	803	10	254	10	244	5	71	12½	72	11¼	90	17½	90	3¾
	4	807	0	797	5	252	15	244	0	71	7½	72	2½	90	8¾	89	16¼
	5	809	0	798	5	253	10	243	10	71	11¼	72	6¼	89	12½	89	6¼
	6	810	0	799	15	253	15	243	15	71	6¼	72	2½	90	2½	89	12½
	7	810	0	801	5	255	5	244	7½	71	11¼	72	6¼	90	3¾	89	16¼
	8	806	0	797	15	255	7½	245	5	71	11¼	72	6¼	90	3¾	89	16
	11	806	0	799	15	259	5	250	5	71	13¾	72	8¾	90	8¾	90	6¼

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	May		June	
	Treated Tons	Yield Oz.*	Treated Tons	Yield Oz.*
Blyvooruitzicht	128,000	84.119	133,000	86,483
Brakpan	146,000	17,419	142,000	17,405
Buffelsfontein‡	148,000	58,635	148,000	59,057
City Deep	119,000	23,590	113,000	23,279
Cons. Main Reef	62,000	12,852	61,000	12,570
Crown Mines	193,000	33,478	198,000	34,729
Daggafontein	233,000	47,156	233,000	47,201
Dominion Reef	40,000	320	41,600	514
Doornfontein‡	105,000	42,263	105,000	42,215
D'rb'n Roodeport Deep	198,000	36,036	193,000	35,606
East Champ D'Or‡	12,500	331	12,500	356
East Daggafontein	106,000	18,020	106,000	18,020
East Geduld	136,000	40,120	132,000	38,610
East Rand P.M.	227,000	55,059	223,000	53,377
Eastern Transvaal Consol	19,400	6,560	19,100	6,536
Ellaton‡	30,000	7,064	29,000	6,893
Freddies Consol.	60,000	13,470	64,000	13,762
Free State Geduld	95,000	82,358	95,000	82,036
Geduld	72,000	12,962	75,000	12,758
Government G.M. Areas‡	54,000	10,902	52,000	10,838
Grootvlei Proprietary	215,000	44,722	216,000	44,823
Harmony Gold Mining	160,000	64,828	165,000	66,041
Hartebeestfontein‡	120,000	55,800	120,000	55,823
Libanon	117,000	27,668	117,000	27,685
Loraine	82,000	17,425	82,000	17,430
Luipaards Vlei‡	120,000	13,423	120,000	13,234
Marievale Consolidated	99,000	24,180	99,000	24,180
Modderfontein East	136,000	13,151	141,000	13,047
New Kleinfontein	79,000	10,266	77,000	9,886
New Klerksdorp‡	11,700	1,305	12,000	1,000
President Brand	118,000	95,606	118,000	95,600
President Steyn	105,000	40,236	100,000	37,509
Rand Leases	186,000	28,004	190,000	28,310
Randfontein‡	173,000	12,344	177,000	13,369
Rietfontein Consolid't'd.	16,000	4,131	15,500	4,072
Robinson Deep	42,000	9,851	44,000	10,311
Rose Deep	23,000	4,362	23,000	4,320
St. Helena Gold Mines	167,000	56,786	167,000	56,784
Simmer and Jack	74,000	13,391	74,000	13,360
S. African Land and Ex.	98,500	20,440	97,500	20,232
S. Roodepoort M.R.	30,000	7,230	30,000	7,188
Spaarwater Gold	11,000	3,418	11,000	3,417
Springs	102,000	14,251	102,000	14,169
Stilfontein Gold Mining‡	167,000	75,150	167,000	75,450
Sub Nigel	66,500	15,155	65,500	15,239
Transvaal G.M. Estates	7,600	1,903	7,000	1,815
Vaal Reefs‡	99,500	44,775	102,500	46,126
Van Dyk Consolidated	75,000	12,421	75,000	12,025
Venterspost Gold	130,000	34,093	126,000	34,014
Village Main Reef	32,700	4,566	30,000	4,624
Virginia O.F.S.‡	136,000	28,560	136,000	28,586
Vlakfontein	52,000	18,700	52,000	18,642
Vogelstruisbult‡	85,000	18,369	85,000	18,364
Welkom Gold Mining	102,000	32,252	102,000	32,155
West Driefontein‡	130,000	120,055	130,000	120,051
West Rand Consol.‡	217,000	22,228	212,000	21,429
Western Holdings	150,000	100,146	154,000	102,715
Western Reefs	145,500	41,104	146,500	41,459
Winkelhaak	85,000	26,776	90,000	28,800
Witwatersrand Nigel	19,800	4,389	20,000	4,437

† 249s. 11d. * 249s. 8d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
June, 1959	17,845,100	69 1	45 2	23 11	28,473,191
July	—	—	—	—	—
August	—	—	—	—	—
Sept.	18,214,200	70 5	45 2	25 3	30,140,529
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	17,670,000	72 2	45 10	26 4	30,559,937
Jan., 1960	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	17,464,400	72 8	46 5	26 3	30,105,571
April	—	—	—	—	—
May	—	—	—	—	—
June	—	—	—	—	—

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
May, 1959	1,641,990	30,371	1,672,361
June	1,665,503	34,465	1,699,968
July	1,700,968	48,414	1,749,382
August	1,699,098	36,052	1,735,150
September	1,701,485	36,567	1,738,052
October	1,718,916	33,576	1,752,492
November	1,688,379	34,903	1,723,282
December	1,662,043	31,309	1,693,352
January, 1960	1,701,110	34,651	1,735,761
February	1,675,248	38,859	1,714,107
March	1,664,514	38,744	1,703,258
April			

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
August 31, 1959	377,257	32,994	410,251
September 30	371,813	32,903	404,716
October 31	365,833	32,567	398,400
November 30	358,746	32,067	390,813
December 31	354,058	31,963	386,021
January 31, 1960	372,254	31,993	404,247
February 29	385,027	32,144	417,171
March 31	388,860	30,696	419,556
April 30			

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To June 1		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	—	—	—
Electrolytic Zinc	16,630	870	4,521
Lake George	16,503	1,444	2,614
Mount Isa Mines**	72,476	5,000†	3,526
New Broken Hill	52,690	6,002	11,104
North Broken Hill	—	—	—
Zinc Corp.	60,400	8,541	10,973
Rhodesia Broken Hill*	—	3,622†	7,590†

* 3 Months. ** Copper 4,175 tons. † Metal.

RHODESIAN GOLD OUTPUTS

	May		June	
	Tons	Oz.	Tons	Oz.
Cam and Motor	—	—	—	—
Falcon Mines	20,500	3,935	20,000	3,919
Globe and Phœnix	—	—	—	—
Motapa Gold Mining	—	—	—	—
Mazoe	3,255	—	—	—
Coronation Syndicate	11,939	—	—	—
Phœnix Prince*	—	—	—	—

* 3 Months.

WEST AFRICAN GOLD OUTPUTS

	May		June	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	53,068	12,191	54,745	12,904
Ariston Gold Mines	41,080	12,956	41,000	11,866
Ashanti Goldfields	35,500	29,150	36,500	29,000
Bibiani	33,000	6,900	32,000	6,750
Bremang	—	5,189	—	6,688
Ghana Main Reef	10,550	4,382	11,466	4,219
Konongo	7,400	3,550	7,226	3,510
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1959		1960	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	46,489	18,077	44,902	29,711
February	43,366	19,806	45,754	29,865
March	48,397	17,394	45,309	29,656
April	—	—	—	—
May	46,423	46,280	—	—
June	49,995	31,386	—	—
July	46,512	32,734	—	—
August	38,727	29,178	—	—
September	50,760	33,837	—	—
October	48,528	32,314	—	—
November	47,916	31,092	—	—
December	47,452	31,175	—	—

WESTRALIAN GOLD PRODUCTION

	1958	1959	1960
	Oz.	Oz.	Oz.
January	66,562	63,924	64,794
February	65,965	65,035	66,789
March	65,420	65,408	61,941
April	60,855	62,686	65,373
May	64,196	64,184	66,682
June	67,929	74,590	—
July	81,106	78,974	—
August	68,610	—	—
September	68,744	—	—
October	70,128	70,427	—
November	67,562	68,858	—
December	120,106	117,474	—
Total	867,187	861,122	—

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To May 24		To June 21	
	Tons	Oz.	Tons	Oz.
Central Norseman	14,169	7,006	14,116	7,708
Gold Mines of Kalgoorlie	41,156	10,753	40,773	10,885
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	31,641	4,641	30,248	5,024
Lake View and Star*	—	—	—	—
North Kalgurli	—	—	—	—
Sons of Gwalia	11,414	2,859	11,880	3,133
Mount Morgan	—	4,822	—	4,627

* 3 Months.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
January, 1959	799,178	227,656	41,277	7,700,672
February	727,843	227,981	32,976	7,798,523
March	807,952	223,728	33,045	7,616,425
April	776,583	225,027	32,778	7,712,425
May	791,199	227,924	34,006	7,713,970
June	768,725	213,486	31,692	7,178,823
July	774,749	221,814	32,172	7,498,030
August	683,819	191,598	29,141	6,428,545
September	754,208	213,772	34,139	7,116,556
October	794,090	227,192	34,733	7,558,567
November	770,437	227,176	35,262	7,600,949
December	775,803	221,377	40,807	7,388,654
January, 1960	778,103	226,856	27,617	7,550,068
February	755,569	222,484	35,033	7,446,848
March	804,309	229,457	37,202	7,646,044
April	779,487	218,393	42,997	7,426,262

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	May		June	
	Tons	Oz.	Tons	Oz.
Clutha River	—	451	—	531
Lampa (Peru)†	—	29,050	—	50,874
New Guinea Goldfields	—	—	4,222	2,767
Yukon Consol.	—	$243,000	—	—

† Oz. Silver : Copper, 86 tons ; 136 tons.

AUSTRALIAN BASE-METAL OUTPUTS

Period	Concentrate Production (Long Tons)		
	Zinc	Copper (*a*)	Lead
1959	246,693	89,162	305,163
Provisional			
1959—January	12,946	7,744	14,874
February	23,658	8,493	26,361
March	27,377	9,776	30,402
April	82,992	8,142	23,477
May	—	—	—
June	—	—	—
July	—	—	—
August	—	—	—
September	—	—	—
October	—	—	—
November	—	—	—
December	—	—	—

(*a*) includes Cu content of direct smelting ore.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	April	May	June
Ampat Tin	58½	68½	60
Austral Amalgamated	—	—	—
Ayer Hitam	—	—	—
Batu Selangor	—	—	—
Berjuntai	170	151	149
Chenderiang	—	—	—
Gopeng Consolidated	—	—	388*
Hongkong Tin	—	—	—
Idris Hydraulic	—	—	—
Ipoh	—	—	—
Jelapang Tin	—	—	—
Kampong Lanjut	81½	89	110
Kamunting	139	142	138
Kent (F.M.S.)	—	—	—
Kepong	—	—	—
Killinghall	—	—	—
Kinta Kellas	29	29	—
Kinta Tin Mines	—	—	—
Klang River	—	—	—
Kramat	63	63	44
Kuala Kampar	91	115	164
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	—	—	—
Lower Perak	167½	105	114
Malayan	—	—	—
Malaysiam	—	—	9½
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	—	—	681*
Pengkalen	—	—	—
Petaling Tin	—	—	261*
Puket	—	—	—
Rahman Hydraulic	—	—	—
Rambutan	—	—	—
Rantau	42½	53½	61½
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	—	—	—
Selayang	—	—	—
Siamese Tin Syndicate (Malaya)	33	34	31
Southern Kinta	271	344	337
Southern Malayan	—	—	—
Southern Tronoh	—	—	—
Sungei Besi	—	—	—
Sungei Kinta	—	—	—
Sungei Way	—	—	—
Taiping Consolidated	—	—	—
Tambah	—	—	—
Tanjong	—	—	162*
Tekka	—	—	—
Tekka-Taiping	—	—	—
Temoh	—	—	—
Tongkah Compound	—	—	—
Tongkah Harbour	108½	148½	202
Tronoh	—	—	—
Ulu Klang	—	—	—

* 3 Months.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	May		June	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines	327	49	371	—
Anglo-Burma Tin*	16	—	—	—
Bangrin	49	—	30	—
Beralt	6	160†	5	163†
Bisichi	40	24½	38	35
Ex-Lands Nigeria	42	—	40	—
Geevor	55	—	55	—
Gold and Base Metal	56	6	—	—
Jantar Nigeria	11	12	—	
Jos Tin	10	—	—	—
Kaduna Prospectors	4	—	5	—
Kaduna Syndicate	16½	—	14	—
Katu Tin	24	—	35	—
Keffi Tin	—	—	—	—
London Nigerian Mines	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	—	—	—	—
Naraguta Karama	5½	—	—	—
Naraguta Tin	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria)	—	—	—	—
Siamese Tin Syndicate	89	—	49	—
South Bukeru	—	—	—	—
South Crofty	71	—	66	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	—	—	—	1

* 3 Months. † Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

March, 1960.

Gold	1,702,489 oz.
Silver	173,545 oz.
Diamonds	52,955 carats.*
Coal	tons.
Copper	(*a*) — tons in matte and copper-gold concentrates. (*b*) 4,826 tons of 99·30%.
Tin	217 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	14,466 tons.
Chrome Ore	73,007 tons.
Manganese Ore	101,333 tons.
Lead Concs.	8 tons.

* *February, 1960.*

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		April	May
Iron Ore	tons	1,304,037	1,483,345
Manganese Ore	,,	115,194	50,139
Iron and Steel	,,	123,013	161,932
Iron Pyrites	,,	29,950	35,259
Copper Metal	,,	43,110	59,090
Tin Ore	,,	3,135	4,541
Tin Metal	,,	158	661
Lead	,,	22,979	13,075
Zinc Ore and Conc.	,,	20,356	15,128
Zinc	,,	15,094	13,018
Tungsten Ores	,,	761	417
Chrome Ore	,,	18,928	30,128
Bauxite	,,	54,829	22,475
Antimony Ore and Concs.	,,	1,219	1,503
Titanium Ore	,,	26,042	40,629
Nickel Ore	,,	—	—
Tantalite/Columbite	,,	19	133
Sulphur	,,	49,619	47,646
Barytes	,,	2,123	2,518
Asbestos	,,	11,420	17,786
Magnesite	,,	10,105	7,600
Mica	,,	594	1,361
Graphite	,,	423	580
Mineral Phosphates	,,	123,622	114,664
Molybdenum Ore	,,	747	421
Nickel	cwt.	64,054	45,706
Aluminium	,,	549,516	167,558
Mercury	lb.	188,383	557,585
Bismuth	,,	21,621	69,330
Cadmium	,,	142,955	314,668
Cobalt and Cobalt Alloys	,,	354,739	261,200
Selenium	,,	29,657	20,423
Petroleum Motor Spirit	1,000 gals.	70,581	62,390
Crude	,,	953,257	918,139

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	106	0	0
,, ,, 80% Technical	,,	97	0	0
Alum, Comml.	,,	25	0	0
Aluminium Sulphate	,,	16	10	0
Ammonia, Anhydrous	per lb.		2	0
Ammonium Carbonate	per ton	59	0	0
,, Chloride, 98%	,,	28	12	6
,, Phosphate (Mono- and Di-)	,,	102	0	0
Antimony Sulphide, golden	per lb.		2	9
Arsenic, White, 99/100%	per ton	47	0	0
Barium Carbonate 98–99%	,,	42	0	0
,, Chloride	,,	45	0	0
Barytes (Bleached)	,,	20	0	0
Benzene	per gal.		5	2
Bleaching Powder, 35% Cl.	per ton	30	7	6
Borax	,,	46	0	0
Boric Acid, Comml.	,,	77	0	0
Calcium Carbide	,,	40	17	9
,, Chloride, solid, 70/75%	,,	13	5	0
Carbolic Acid, crystals	per lb.		1	6
Carbon Bisulphide	per ton	62	10	0
Chromic Acid (ton lots)	per lb.		2	2½
Citric Acid	per cwt.	9	15	0
Copper Sulphate	per ton	85	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	2
Cresylic Acid, refined	,,		7	0
Hydrochloric Acid 28° Tw.	per carboy		11	6
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iron Sulphate	per ton	3	5	0
Lead, Carbonate, white	,,	116	15	0
,, Nitrate	,,	110	0	0
,, Oxide, Litharge	,,	106	5	0
,, Red	,,	104	5	0
Lime Acetate, brown	,,	40	0	0
Lithopone	,,	57	10	0
Magnesite, Calcined	,,	20	0	0
,, Raw	,,	13	0	0
Magnesium Chloride, ex Wharf	,,	16	0	0
,, Sulphate, Comml.	,,	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.		6	1
Nickel Sulphate	per ton	189	0	0
Nitric Acid, 80° Tw.	,,	32	0	0
Oxalic Acid	,,	132	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Potassium Bichromate	,,		1	2½
,, Bromide	,,	11	2	6
,, Carbonate (hydrated)	per ton	74	10	0
,, Chloride	,,	21	0	0
,, Iodide	per kilo		15	3
,, Amyl Xanthate	,,	Nominal		
,, Hydrate (Caustic) flake	per ton	92	0	0
,, Nitrate	per cwt.	4	1	0
,, Permanganate	per ton	198	0	0
,, Sulphate, 50%	,,	20	13	0
Sal-Ammoniac	,,	70	0	0
Sodium Acetate	,,	63	0	0
,, Arsenate, 58–60%	,,	Nominal		
,, Bicarbonate	,,	18	10	0
,, Bichromate	per lb.		1	0
,, Carbonate (Soda Ash) 58%	,,	16	0	0
,, Chlorate	,,	77	0	0
,, Cyanide	per cwt.	6	18	10
,, Hydrate, 76/77%, solid	per ton	33	0	0
,, Hyposulphite, Comml.	,,	35	0	0
,, Nitrate, Comml.	,,	29	0	0
,, Phosphate (Dibasic)	,,	40	10	0
,, Prussiate	per lb.		1	0½
,, Silicate	per ton	11	10	0
,, Sulphate (Glauber's Salt)	,,	9	15	0
,, ,, (Salt-Cake)	,,	10	0	0
,, Sulphide, flakes, 60/62%	,,	38	12	6
,, Sulphite, Comml.	,,	27	15	0
Sulphur, American, Rock (Truckload)	,,	13	0	0
,, Ground, Crude	,,	17	10	0
Sulphuric Acid, 168° Tw.	,,	12	0	0
,, ,, free from Arsenic, 140° Tw.	,,	8	10	0
Superphosphate of Lime, 18% P_2O_5	,,	14	18	6
Tin Oxide	,,	Nominal		
Titanium Oxide, Rutile	,,	172	0	0
,, White, 25%	,,	85	0	0
Zinc Chloride	,,	95	0	0
,, Dust, 95/97% (4-ton lots)	,,	136	0	0
,, Oxide	,,	105	0	0
,, Sulphate	,,	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	June 8, 1960 £ s. d.	July 8, 1960 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	2 17 6	2 13 9
Blyvooruitzicht (2s. 6d.)	1 4 9	1 4 6
Bracken (10s.)	1 3 9	1 2 6
Brakpan (3d.)	4 3	4 0
Buffelsfontein (10s.)	1 19 9	1 19 9
City Deep	14 0	13 6
Consolidated Main Reef	14 3	13 0
Crown Mines (10s.)	1 1 9	1 1 0
Daggafontein (5s.)	19 3	17 3
Dominion Reefs (5s.)	11 6	10 3
Doornfontein (10s.)	1 8 3	1 8 0
Durban Roodepoort Deep (10s.)	1 5 0	1 5 6
East Champ d'Or (2s. 6d.)	1 9	2 0
East Daggafontein (10s.)	8 3	8 0
East Geduld (4s.)	16 6	15 6
East Rand Ext. (5s.)	1 0 0	18 3
East Rand Proprietary (10s.)	1 6 0	1 6 6
Freddies Consol.	1 6	1 9
Free State Dev. (5s.)	4 6	4 0
Free State Geduld (5s.)	5 16 3	5 13 9
Free State Saaiplaas (10s.)	12 6	10 6
Geduld	2 13 0	2 9 6
Government Gold Mining Areas (3d.)	2 3	2 3
Grootvlei (5s.)	18 0	17 6
Harmony (5s.)	1 7 3	1 7 3
Hartebeestfontein (10s.)	2 9 6	2 3 6
Libanon (10s.)	12 6	12 0
Loraine (10s.)	1 6 3	1 4 6
Luipaards Vlei (2s.)	7 9	7 0
Marievale (10s.)	1 4 3	1 4 0
Modderfontein B (3d.)	1 9	1 9
Modderfontein East	12 0	10 9
New Kleinfontein	3 9	3 3
New Pioneer (5s.)	1 12 0	1 10 0
New State Areas (15s. 6d.)	1 0	9
President Brand (5s.)	2 16 3	2 18 0
President Steyn (5s.)	1 1 3	1 0 9
Rand Leases (9s. 3d.)	6 0	5 6
Randfontein	16 6	16 0
Rietfontein (3d.)	3 6	3 0
Robinson Deep (5s. 6d.)	4 6	4 3
Rose Deep (3d.)	10 0	6 9
St. Helena (10s.)	3 5 6	3 3 6
Simmer and Jack (1s. 6d.)	1 3	1 0
South African Land (3s. 6d.)	12 3	11 9
Springs (3d.)	1 3	1 3
Stilfontein (5s.)	1 11 6	1 10 0
Sub Nigel (3d.)	9 3	8 0
Vaal Reefs (5s.)	2 2 3	1 18 6
Van Dyk (3d.)	3 6	2 6
Venterspost (10s.)	19 6	18 9
Virginia (5s.)	3 6	3 3
Vlakfontein (10s.)	15 6	15 6
Vogelstruisbult (3d.)	5 6	4 6
Welkom (5s.)	13 9	13 9
West Driefontein (10s.)	4 0 0	4 0 0
West Rand Consolidated (10s.)	17 3	16 9
West Witwatersrand Areas (2s. 6d.)	2 15 0	2 10 6
Western Holdings (5s.)	5 15 0	5 12 6
Western Reefs (5s.)	1 6 3	1 5 3
Winkelhaak (10s.)	19 9	1 0 0
Witwatersrand Nigel (2s. 6d.)	1 0	1 0
Zandpan (10s.)	14 6	13 9
RHODESIA:		
Cam and Motor (2s. 6d.)	—	—
Chicago-Gaika (10s.)	16 3	16 3
Coronation (2s. 6d.)	5 3	5 0
Falcon (5s.)	9 0	9 0
Globe and Phœnix (5s.)	1 11 3	1 11 3
Motapa (5s.)	—	—
GOLD COAST:		
Amalgamated Banket (3s.)	9	9
Ariston Gold (3s. 6d.)	4 0	4 0
Ashanti Goldfields (4s.)	1 0 0	19 3
Bibiani (4s.)	2 9	2 9
Bremang Gold Dredging (5s.)	3 6	3 0
Ghana Main Reef (5s.)	3 0	2 9
Konongo (2s.)	1 6	1 9
Kwahu (2s.)	5 9	5 9
Offin River (2s. 6d.)	3 6	3 9
Western Selection (5s.)	4 9	4 9
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	1 6	1 6
Gold Mines of Kalgoorlie (10s.)	7 3	7 0
Great Boulder Propriet'y (2s.), W.A.	11 3	11 3
Lake View and Star (4s.), W.A.	1 6 3	1 5 0
Mount Morgan (10s.), Q.	15 9	15 9
New Guinea Gold (4s. 3d.)	2 0	1 9
North Kalgurli (1912) (2s.), W.A.	9 6	9 3
Sons of Gwalia (10s.), W.A.	2 6	2 6
Western Mining (5s.), W.A.	9 6	9 3

	June 8, 1960 £ s. d.	July 8, 1960 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	1 7 0	1 7 6
Kentan Gold Areas	1 6 9	1 6 3
St. John d'el Rey, Brazil	6 0 0	4 12 6
Yukon Consolidated ($1)	4 6	4 3
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	18 6	18 3
Esperanza (2s. 6d.), Cyprus	2 0	2 3
Indian (2s.)	5 6	5 6
MTD (Mangula) (5s.)	9 0	8 6
Messina (5s.), Transvaal	1 1 0	1 0 0
Mount Lyell (5s.), Tasmania	5 3	5 6
Nchanga Consolidated, N. Rhodesia	2 16 0	3 1 3
Rhokana Corporation, N. Rhodesia	2 9 6	2 10 0
Roan Antelope (5s.), N. Rhodesia	6 6	6 3
Tanganyika Concessions (10s.)	1 10 6	1 11 9
LEAD-ZINC:		
Broken Hill South (1s.), N.S.W.	12 9	12 3
Burma Mines (3s. 6d.)	1 6	1 9
Consol. Zinc Corp. Ord.	3 17 0	4 0 0
Lake George (5s.), N.S.W.	3 3	3 9
Mount Isa, Queensland (5s. Aust.)	2 16 0	2 12 0
New Broken Hill (5s.), N.S.W.	2 10 6	2 9 6
North Broken Hill (10s.), N.S.W.	1 3 0	1 1 9
Rhodesia Broken Hill (5s.)	9 6	8 3
San Francisco (10s.), Mexico	19 3	19 9
TIN:		
Amalgamated Tin (5s.), Nigeria	10 0	10 9
Ampat (4s.), Malaya	13 0	12 9
Ayer Hitam (5s.), Malaya	5 6 3	6 2 6
Beralt (5s.), Portugal	1 12 0	1 12 3
Bisichi (2s. 6d.), Nigeria	6 0	6 0
Ex-Lands (2s.), Nigeria	3 3	3 3
Geevor (5s.), Cornwall	1 4 0	1 3 3
Gold Base Metals (2s. 6d.), Nigeria	2 0	2 6
Hongkong (5s.), Malaya	9 9	11 9
Jantar Nigeria (3s.)	6 0	6 3
Kaduna Syndicate (2s.), Nigeria	2 7½	3 3
Kamunting (5s.), Malaya	18 9	18 6
Malayan Tin Dredging (5s.)	1 6 6	1 6 3
Mawchi Mines (4s.), Burma	1 3	1 3
Naraguta Karama (5s.), Nigeria	1 6	1 6
Pahang (5s.), Malaya	10 9	12 0
Siamese Synd. (5s.)	16 9	15 6
South Crofty (5s.), Cornwall	4 7½	4 6
Southern Kinta (5s.), Malaya	1 8 9	1 8 3
Southern Malayan (5s.)	1 0 9	1 0 3
Southern Tronoh (5s.), Malaya	16 3	1 2 6
Sungei Besi (4s.), Malaya	1 14 0	1 10 6
Sungei Kinta, Malaya	16 6	16 6
Tekka (12s. 6d.), Malaya	9 6	9 9
Tronoh (5s.), Malaya	1 19 9	2 2 3
United Tin Areas (2s. 6d.), Nigeria	2 6	2 6
DIAMONDS:		
Anglo American Investment	12 15 0	12 0 0
Consol African Selection Trust (5s.)	1 2 0	1 3 3
Consolidated of S.W.A. Pref. (10s.)	10 3	10 3
De Beers Deferred (5s.)	7 6 3	7 3 0
FINANCE, Etc.		
African & European (10s.)	3 5 0	3 2 6
Anglo American Corporation (10s.)	7 10 0	7 5 0
Anglo Transvaal 'A' (5s.)	2 1 3	1 18 9
British South Africa (15s.)	3 19 0	3 18 6
British Tin Investment (10s.)	1 10 9	1 10 6
Broken Hill Proprietary	3 10 0	3 7 6
Camp Bird (10s.)	8 9	8 3
Central Mining	3 9 3	3 9 0
Central Provinces Manganese (10s.)	1 11 9	1 10 3
Consolidated Gold Fields	3 0 3	2 18 9
Consolidated Mines Selection (10s.)	1 9 6	1 11 0
Corner House	14 9	14 3
East Rand Consolidated (5s.)	2 3	2 0
Free State Development (5s.)	4 6	4 0
General Exploration O.F.S. (2s. 6d.)	4 0	3 6
General Mining and Finance	4 12 6	4 6 3
Hendersons (4s.)	9 6	9 3
Johannesburg Consolidated	2 10 3	2 7 6
London & Rhod. M. & L. (5s.)	5 6	6 0
London Tin Corporation (4s.)	12 6	13 0
Lydenburg Est. (5s.)	14 0	13 3
Marsman Investments (10s.)	2 0	1 9
National Mining	2 3	2 0
Rand Mines (5s.)	3 12 6	3 10 6
Rand Selection (5s.)	2 8 3	2 2 6
Rhodesian Anglo American (10s.)	3 5 6	3 4 0
Rhodesian Corporation (5s.)	3 0	2 9
Rhodesian Selection Trust (5s.)	11 9	10 6
Rio Tinto (10s.)	1 15 0	1 11 3
Selection Trust (10s.)	4 12 6	4 8 9
South West Africa Co. (3s. 4d.)	16 0	15 0
Union Corporation (2s. 6d.)	2 10 6	2 9 6
Vereeniging	5 2 6	4 17 6
West Rand Inv. Trust (10s.)	2 10 0	2 5 0

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Diesel Traction Underground

In the United States Bureau of Mines Report of Investigations **5616**, J. C. Holtz reviews "Safety with Mobile Diesel-Powered Equipment Underground." The Report says that mine operators and tunnel contractors became interested in internal-combustion engines as prime movers for underground mining equipment soon after these devices were invented. When the Bureau was established in 1910 gasoline engines were being used in mines and tunnels, sometimes with fatal consequences. The hazards from these engines in underground service were studied by the Bureau in early projects and the more important ones were determined to be:

(1) Fire or explosion during the handling or use of volatile liquid fuels.

(2) Unhealthful conditions caused by the discharge of toxic and objectionable constituents in the exhaust into the underground atmosphere.

(3) Ignition of flammable atmospheres by the hot surfaces or the intake and exhaust openings of the engine and by its electrical equipment.

From practical experience with gasoline-powered equipment it quickly became evident that these hazards were difficult to control. The exhaust gas contained high concentrations of toxic carbon monoxide which created dangerous local conditions, even when large volumes of air were used to ventilate the mine. These conditions were recognized by State authorities and most States developed laws or regulations that prohibited use of gasoline or other volatile fuels in mines except in very limited quantities and under careful supervision. Because of these conditions gasoline-powered machines have virtually disappeared from modern mines.

Diesel mine locomotives were first introduced in German mines in 1927 and later adopted in the mines of other European countries and finally in England. In the United States the Bureau began to evaluate the performance of modern high-speed diesel engines in relation to mine service about 20 years ago. Both research and practical experience since have shown that diesel engines are not inherently safe in underground operations. However, with proper precautions and adequate ventilation they can be used safely. Although most States prohibit liquid fuels in mines many permit diesel engines underground by special exemptions provided that strict control regulations are followed. Consequently the number of modern high-speed diesel engines used in metal mines and tunnels is increasing rapidly.

Essentially, the Report says, the same hazards exist in mines using either diesel or gasoline engines. However, the less volatile fuel and less objectionable exhaust-gas characteristics of diesel engines when properly adjusted reduce the degree of hazard as compared with gasoline engines. The Report considers research results that illustrate the need for some of the more important approval requirements as well as other important practical precautions needed for the safe use of diesel equipment in underground mines and tunnels.

An important factor in the safety of diesel engines in mines is the characteristics of the fuel. Diesel fuel normally is a petroleum distillate considerably less volatile than gasoline; it has little tendency to form an explosive mixture with air at normal temperatures. To ensure this characteristic the Bureau recommends a flash point of 140° F. or higher. Otherwise the fuel should conform to the engine manufacturer's specifications for viscosity, pour point, cetane number, carbon residue, and water. The sulphur content should not exceed 0·5%. By restricting sulphur in the fuel the concentration of toxic sulphur oxides in exhaust gas is controlled so that the concentration of these oxides in the mine atmosphere remains within safe hygienic limits when ventilation is safe for other constituents of the exhaust.

All engine manufacturers recommend that diesel fuel be free from water, sediment, and dirt. Clean fuel is necessary to reduce the possibility of damage and malfunctioning of fuel-injection systems and to avoid excessive maintenance. Badly worn or improperly functioning injection valves can increase the hazards from objectionable and harmful constituents in exhaust gas.

Although diesel fuel is less hazardous than gasoline it is a flammable liquid and should be handled accordingly. Whenever possible fuel storage should be on the surface and the fuel tanks of the diesel machines should be filled above ground. Only limited amounts of fuel, no more than enough for one day's operation of the diesel units, should be taken underground. Such fuel should be transported and stored only in strong, tight metal containers provided with positive closing devices and safety vents. All fuel taken underground should be stored in a closed compartment constructed of incombustible materials and well ventilated. The return air from this storage compartment should not pass through active workings. Liquid-tight curbs and sills should be provided to form a reservoir of greater capacity than the maximum volume of fuel stored in the compartment. The fuel tanks of mobile diesel machines should be filled only at the fuel-storage compartment. An ample supply of

sand or other suitable incombustible material should be conveniently available to absorb any fuel that may be spilled accidentally. Suitable fire extinguishers should be installed at the underground fuel storage compartment, at repair shops, and on all diesel machines.

The advantages of this less-volatile fuel should not be sacrificed in the starting system for the engine. Electric, hydraulic, or pneumatic starting should be used. Electric starting may be assisted by properly installed glow-plugs if necessary. Gasoline-starting engines or other devices using volatile fuels or flames are not accepted on approved equipment.

Undiluted exhaust gas from any internal-combustion engine is an unsatisfactory environment for workmen and that from diesel engines is no exception. A safe atmosphere in underground mines and tunnels can be maintained only when adequate positive ventilation is supplied to dilute and remove the exhaust gas and to maintain oxygen at a safe concentration. Evaluating the health hazard involves determining the concentrations of toxic and objectionable constituents in the exhaust. These constituents include carbon dioxide, carbon monoxide, aldehydes, oxides of sulphur (if the fuel contains sulphur), soot, and oxides of nitrogen. When the quantities of these gases in the exhaust have been determined safe ventilation can be calculated. From engine tests the operating conditions that produce the least quantity of some of these harmful gases can be specified.

Following the exhaustive test work reviewed in the Report it is concluded that safety with mobile diesel-powered equipment in non-coal mines and tunnels depends chiefly upon proper adjustment and maintenance of the engine, suitable rapid dilution of the exhaust, and adequate positive mechanical ventilation to dilute and remove the exhaust from the mine and to restore oxygen used in the combustion process. The chief harmful and objectionable gases always in the exhaust are carbon dioxide, carbon monoxide, and oxides of nitrogen; their concentrations are related to the fuel : air ratio at which the engine is operated. The concentration of carbon dioxide in the exhaust varies in almost direct proportion to the fuel : air ratio used in operating the diesel engine. Ventilation based on carbon dioxide is the minimum that should be supplied when any diesel-powered machine is used underground. Usually more ventilation must be supplied.

Operation of any diesel engine in the rich range of fuel : air ratios produces excessive quantities of carbon monoxide and smoke that cannot be removed from the mine safely and economically. Consequently adjustment of the maximum fuel-injection rate must be made to avoid these exhaust characteristics. This necessary adjustment does not reduce objectionably the useful power output of the engine. When engines are so adjusted carbon monoxide in the exhaust seldom is the controlling factor in determining safe ventilation for diesel engines in proper mechanical adjustment.

Oxides of nitrogen always are present in diesel-exhaust gas. They are formed by the reaction of oxygen and nitrogen in the air charge at high temperatures that prevail during combustion in the engine. Their concentrations in the exhaust cannot be controlled by simple adjustments of most engines; they are related to fuel : air ratio, design of the combustion space, and factors that affect fuel atomization, volatilization, and distribution. Maximum concentrations of the oxides usually are greater in the exhaust of direct-injection engines and less in that of indirect-injection engines. High-pressure supercharging or turbocharging appears to increase the maximum concentration in the exhaust of any diesel engine. Safe ventilation often is controlled by the maximum concentration of oxides of nitrogen.

Aldehydes in diesel exhaust seem to be the chief cause of odour and eye and nasal irritation sometimes observed in mines. Odour and irritation are proportional to the concentration of aldehydes in the mine atmosphere. Their concentration always is reduced to a safe and inoffensive level when adequate ventilation is supplied for other constituents in the exhaust

Sulphur in the fuel causes the formation of toxic and irritating oxides of sulphur in the exhaust in proportion to the fuel : air ratio in the normal operating range of diesel engines. The concentration of these oxides in the mine atmosphere is controlled to a safe level in mines by limiting the maximum concentration of sulphur in diesel fuel to 0·5% by weight.

Conditioners are used on mobile diesel-powered machines to cool the hot exhaust gas and quench any sparks from combustion. Cooling to about 160° F. is accomplished by adiabatic saturation when hot exhaust is bubbled through water. This action dissolves some of the aldehydes but has little or no significant effect on the concentrations of other objectionable exhaust constituents. Hence, the use of conditioners does not reduce the air required for safe ventilation of mines and tunnels. Complete removal of aldehydes from diesel exhaust can be substantially obtained when well-designed conditioners are filled with a 10% aqueous solution of sodium sulphite inhibited against oxidation with 0·5% hydroquinone. No other practical solutions have yet been discovered that are highly effective in removing other toxic or objectionable constituents from diesel exhaust.

The exhaust-gas dilution system required on approved diesel machines reduces substantially the danger that local areas may become highly contaminated with exhaust and that greater hazards may develop from exhaust gas recirculated into the engine's air intake system. Dilution also greatly reduces the rate at which nitric oxide in diesel-exhaust gas is transformed into nitrogen dioxide in the mine atmosphere. Nitrogen dioxide now is regarded as probably the most dangerous of the oxides of nitrogen in its deleterious effect on people.

In mountainous regions the atmosphere is less dense and a lower weight of air is drawn into diesel engines. At higher altitudes the maximum fuel-injection rate of the engine must be reduced to prevent excessive generation of carbon monoxide in the exhaust. A table showing the proper maximum fuel-injection rate at different altitudes is included in the caution statement for all approved diesel machines. The safe ventilation rate for properly-adjusted diesel engines is the same at all altitudes.

Experience with diesel engines in mines suggests that the production of carbon monoxide in the exhaust at high loads increases with time in service. Coincidentally the production of oxides of nitrogen decreases noticeably. Original performance characteristics are restored when the worn parts are replaced and the engine is properly adjusted. Thus preventive maintenance is necessary to assure safety when diesel machines are used underground.

Safe ventilation is related to both the size and design of diesel engines and the safe hygienic limits for exposure of people to the multiple toxic and objectionable gases in the mine atmosphere. Ventilation should be based on rational calculations from the results of comprehensive engine tests using a suitable factor of safety. Determination of ventilation from general empirical relationships is unreliable and may be dangerous.

Approved mobile diesel-powered equipment has been tested and inspected to ensure its safety underground. Such machines are equipped with a satisfactory conditioner and dilution device in the exhaust system. Approval papers specify a suitable fuel rate for adjustment of the engine at different altitudes and a safe ventilation rate. The attachment of an approval plate is the manufacturer's evidence that the equipment meets the requirements of the Bureau's schedule 24. The Bureau recommends using only approved mobile diesel-powered equipment in non-coal mines and tunnels under ground.

Washing Down Stopes at Bicroft

The "Hydraulic Clean-Down of Stopes at Bicroft Uranium Mines, Ltd.," is described by G. W. Hjalmarson in the *Canadian Mining Journal* for May. At this mine, the author says, shrinkage stoping is used mainly, with timbered back stopes using rock bolts, timber, and pillars for ground support. All stopes are rock-bolted while mining, in order to provide safe working conditions to the breaking crews and the clean-down crew, which must remove or follow down the ore at a later date, and to prevent dilution of the ore. The hanging-wall is always bolted and in many cases where conditions require it the foot-wall is also rock-bolted.

The orebodies generally dip to the east at approximately 50°. This rather flat dip results in some 21% of the broken ore in stopes being left on the foot-wall and on top of pillars after the chutes have been pulled empty.

In order to get this part of the broken ore containing a good percentage of high fines, it was necessary to institute a clean-down programme. To move the ore down the foot-wall to the chutes two-man crews are used.

In the first method tried the main tools were air blow pipes and the conventional pick and shovel. In some cases slushers were used for part of the work. The men are required to wear safety belts and ropes during most of the operation. This method proved to be slow, costly, and unhealthy. The air blow pipes created a lot of dust and left a coating of fines on both hanging-wall and foot-wall. Hand mucking was slow due to dry muck and was further impeded by the safety belts and ropes which the men had to wear.

A blow pipe using both air and water was then devised which consisted essentially of a ½-in. pipe fitted inside a 1-in. pipe. The ½-in. pipe was connected to a water hose and the 1-in. pipe to an air hose. A slight increase in production was obtained with this blow pipe, with a reduction in dust count in the working area. Again the safety rope *plus* two hoses made this a cumbersome and slow outfit to set up.

Test work was then carried out with water only, using pumps to provide the necessary pressure. High-pressure hydraulic clean-down proved encouraging both from the point of view of efficiency and dust control. However, the water available from the main shaft was not adequate to supply both the quantity required for clean-down and meet the requirements of the drillers, etc. Further, water pressures on the levels had to be kept near that of the air pressure so that the drill machines would get proper lubrication. High-pressure water could not be supplied to clean-down crews on existing water lines without causing excessive breakage to water hoses of the drillers. Various pumping arrangements were checked and found either too costly or too cumbersome.

As hydraulic clean-down had proved to be the most effective and, since extra capacity for pumping was available from the eighth level sump, it was decided to run a 3-in. water line down the shaft from surface to the 3rd level. This was to be used for cleaning down stopes from the 3rd to the 6th level.

On the 3rd level a lateral 2-in. line was installed down the main haulageway to the mined-out stopes. Wherever possible existing pipe-lines not required for mining were used. From this level the pipe-line was carried down to the 4th level through a completed stope. The high-pressure water line then followed the combined escapement and ventilation raise to the 5th and 6th levels.

There is no pressure reduction valve from surface to the 3rd level, a distance of 325 ft., and pressure on the 3rd level is 110 p.s.i. by actual measurement. At the 6th level actual pressure is in the 250 p.s.i. range. All valves used on the high-pressure line are gate valves to prevent the sudden "shut off" that occurs when using a plug valve which might result in damage to the pipe-lines.

In the actual clean-down operation the 2-in. pipe-line is reduced to 1¼-in. hoses. No valve is used on the discharge end, water being controlled from a valve on the pipe-line. No hoses with mends are used. Once a hose is punctured and mended it is sent to be used on a mucking machine and is replaced with a new one. At each hose connexion a safety clamp is installed on each hose and connected by an adjustable bolt. This is to ensure against failure of the threads at the connecting nipple.

A 3-ft. long nozzle of 1¼-in. pipe fitted with two handles is used. A reducer from 1¼ in. to 1 in. is used when required for hard packed muck—such as, drift bottom, etc.—at the start of a clean-down.

Once the actual clean-down of the stope is started the full 1¼-in. discharge is used. In this phase of operations the volume of water is of equal if not greater importance than pressure. Both the foot-wall and hanging-wall are washed down as the work progresses. The washing eliminates much of the dust that could dry out later and contaminate the air circulating through the stopes. This is very important from a ventilation standpoint since during some phases of operations it is convenient to channel air to active headings through empty stopes.

The high-pressure hose, having an effective range of about 35 ft. has considerably reduced the need for extra ladderways and catwalks to gain access to the various benches in the stope. This results in a saving in material and labour.

The crew installs ladderways, also taking care of any loose ground conditions they may encounter. Most of the actual wash down of stopes takes place from the ladderway. Timbering of the stopes has been altered somewhat with a view to accelerating the clean-down of the cones of ore between chutes. This was formerly done with small slushers. In narrow stopes the back is taken down higher than normal so that an inverted " V " of timber can be put in between the chutes. In wider stopes china chutes are placed in the flat timber between the chutes so that the muck can be easily removed with shovels once the hydraulic system is no longer effective due to the flatness of the timber.

Clean-down crews on a contract basis are allotted several stopes to work in. Once the muck is washed down near its angle of repose the crews move to the next stope. This allows time for the water to drain through before the ore is pulled. There is a surprisingly small amount of spill to be cleaned up under the chutes using this procedure. The chutes are pulled almost empty before the clean-down crew return for the next washing.

Another interesting use of the hydraulic clean-down has been as a replacement for a slusher. Where formerly a slusher hoist and scraper had to be moved in to clean muck down on the footwall when the ore took a flat roll, a high-pressure hose is now often used. This means a considerable saving in time as the job can often be done in the time it took to move a slusher hoist and scraper into the back out of the stope. In extremely flat-lying sections, however, the slusher still has to be used.

Hydraulic clean-down having proved itself, an installation is now being readied to supply water for clean-down of stopes below the 6th level. Water from the ditch drain line in the shaft above the 5th level is to go into a settling sump and over a weir to a clear water basin. From the clear basin it is to be piped to and down the ventilation escapement rise for use on the levels below. This will considerably decrease the amount of water that presently has to be introduced into the mine from surface and eventually pumped back up, thereby effecting a saving on pump wear and power consumption.

In conclusion, the author says, the economics of the old as against the new system of clean-down are :

Tons per man shift in clean-down are increased by 68%.

Cost per ton in clean-down is decreased by 43%.

Australian Beach Sands Treatment

In the course of a review of " Ore Dressing Developments in Australia, 1959," appearing in the *Chemical Engineering and Mining Review* of Melbourne for April 16, J. T. Woodcock discusses beach sand treatment. He says that in the year under review the operating companies continued to face difficult times and only those with assured contracts continued operation. Nearly all have been increasing their efforts to improve operating efficiencies and reduce production costs. In general, the beach sand industry is becoming much more control conscious and a number of plants have reported improved control methods.

National Minerals, the author says, has been constructing a new type of dredge, claimed to be the largest floating rutile concentration plant in the world. Its measurements are length 115 ft. and width 42 ft. with 10 ft. between top and bottom decks. Displacement is achieved by a series of cylindrical tanks 4½ ft. dia. by 42 ft. long. A total displacement of 390 tons is available. A complete workshop is incorporated in the dredge and the layout provides for ready maintenance. Future extensions can be made without interrupting production. Some 300 h.p. is required by the complete plant. The dredge is designed to treat 300 tons per hour, for three shifts, seven days per week. At this feed rate, from material containing as little as 0·5% heavy mineral, the plant is designed to produce concentrates containing at least 80% heavy mineral.

For feeding the dredge two distinct units have been provided. One is a drag-line to provide the bulk of the feed and the other is an auxiliary 8/6 suction pump to clean up spillage and loose material left on the bottom of the pond. Concentration is to be performed by company-designed rubber spirals in three stages. There are 250 rougher spirals, 45 cleaners, and 27 recleaners. Final concentrate will be pumped to the shore and transported to the company's dry separation plant at Wickham, Newcastle. Tailing will be deposited at the rear of the pond and will require little extra handling to leave the land level.

Titanium and Zirconium Industries in the first half of 1959 increased by 25% the dredging and concentrating capacity of its two large dredges operating on the east coast of North Stradbroke Island. An additional 68 fibre-glass spirals were added to the rougher and cleaner stages to make a total of 120 roughers, 40 cleaners, and 20 recleaners on each dredge. Pump motors of increased horsepower were installed where necessary. The combined throughput of the two dredges averages 225,000 tons of new feed per calendar month. Results of the expansion programme have been as planned.

N.S.W. Rutile Mining put a new dredge into operation at its Fingal A spiral plant. The dredge is 1,200 ft. from the spiral plant and two-stage pumping was introduced to transport the feed from the dredge to the spiral plant. Both the dredge pump and the stage pump are 8/6 Warman sand pumps driven by 70-h.p. motors. In the tabling plant two additional Wilfley tables and 14 Humphreys spirals have been installed. The company has also erected a new bagging plant.

Western Titanium installed an air table to reduce the fine free silica content of its zircon concentrates.

Westralian Oil, Ltd., continued its pilot-plant operations from 1958 into the first half of 1959, when erection of the full-scale plant commenced. With minor changes the plant will operate on the flow-sheet published last year. Design capacity of the plant is 100,000 tons of heavy mineral per year.

Initially the plant will produce for sale only ilmenite and leucoxene. The non-conductors (zircon and monazite) will be stockpiles.

Titanium Alloy Manufacturing, operating on a staggered roaster, one Fanning concentrating plant, one spiral concentrating plant, and a dry separation plant. Originally the spiral plant consisted of 42 concrete spirals having a total capacity of 25 tons per hour. This plant has been extended in stages to 112 spirals. Treatment rate is 70 tons of new feed per hour and the same number of operators are required as were needed in the original plant. The original suction dredge, using a 4-in. pump, has been replaced by a dredge with a 6-in. pump obtained from the now disused second Fanning plant

At the Cudgen plants of *Associated Minerals Consolidated* a unit spiral plant has been based on 42 primary, 16 secondary, and 8 tertiary spirals. At the start of 1959 the Cudgen North plant was composed of three units and the Cudgen South plant of two units, giving a total of 330 spirals. These plants have now been altered to give two units at each plant, while maintaining approximately the same total number of spirals. Advantages achieved are a saving on labour and more complete control of plant operations.

N.S.W. Rutile Mining has installed two additional Wilfley tables (giving eight tables in parallel) and a bank of 14 Humphreys spirals. These spirals scavenge middlings from the primary tables. Both the tables and the spirals reject a finished tailing. In the dry separation plant the circuit has been altered to permit simultaneous production of rutile and zircon.

Control

The beach sand industry is becoming more control conscious. Several plants have reported that they have improved their control in general and some specific items have been noted.

On *National Minerals Pty., Ltd.'s*, new dredge, for control over the spirals, one man, unassisted, will have immediate information over the storage, pulp, density and primary, secondary and tertiary spirals treatment.

At *Associated Minerals Consolidated* mining and preliminary concentration is carried out at Cudgen by two plants. Cudgen North is a land-based spiral plant fed by a floating dredge which is moving northwards, while Cudgen South is a fully-floating spiral plant which is working southward. The lease ahead of each plant has been drilled E-W at 30-ft. intervals and N-S at 300-ft intervals, to enable accurate plotting of old shore lines and mineral dispositions with calculation of ore reserves. This drilling information has been used to establish pond and dredging-level control. Normal dredging is carried out at 6·5 ft. and the pond is swept at 8 ft. At both plants pond levels are maintained at the required heights by pumping installations using creek water. To evaluate overall mining recovery the area will be close drilled after mining. Test work carried out over small areas indicates a probable dredging efficiency of 90 p.c.

The dredge operator varies the dredging rate to maintain a reasonably constant level of sand in the constant density cone. Recording ammeters are to be installed on this service to obtain records of plant down time. From the constant-density cone the sand is fed at a specified rate and per cent. solids to the primary spirals. To do this the feed pump speed and dilution water valves were adjusted to give the values required and the pump motor amperage noted. This amperage is used by the operator as an indication of feed rate.

Improved control of dredging and plant operation has been reflected by increased productivity in terms of increased recovery of heavy mineral per cubic yard treated. Production costs per ton of heavy mineral have followed inversely this productivity increase and are expected to drop still further.

Titanium and Zirconium Industries has introduced automatic sampling in the dredge concentrators and within the dry separation plant. Metallurgical efforts have been aimed at maintaining optimum grades and recoveries. In the dry separation plant the circuit remains unchanged but weighing of the feed has been introduced. A batch weigher has been installed and is giving excellent service in checking the actual throughput. Batches are periodically checked by dead weight and the unit permits accurate knowledge of both the plant input and concentrate delivery, thus eliminating uncertainties which previously existed in plant balances.

Monazite

Associated Minerals Consolidated has found that two-stage tabling of the magnetic fraction of the non-conductors, followed by drying, and then a single-stage magnetic pass, gives a product containing more than 90% monazite. Recoveries per unit pass are quite low, especially in the wet section, owing to the fine nature of both zircon and monazite, coupled with the closeness of their specific gravities. As far as possible the whole circuit is kept locked in order to keep up the recovery of monazite.

At the *Titanium Alloy Manufacturing Co.* experimental work has shown that because of the presence of a high proportion of magnetic zircon a satisfactory recovery of monazite cannot be made by gravity and dry separation methods. However, a successful method was developed in small-scale laboratory tests and a batch pilot plant was erected. In this plant the non-conductor magnetic by-product from the dry plant was first conditioned in boiling soap solution. After water washing the residual soap was converted to fatty acids with sulphuric acid. This enabled the zircon to be removed by froth flotation. The flotation residue (monazite-garnet) was wet-tabled to give a high-grade monazite product. Over one ton was made, but further work on the project will depend on an increase in the price and demand for monazite.

General

Associated Minerals Consolidated contends that the basis of good spiral-plant separation is clean wash water. At its Cudgen North land-based plant the bulk of the wash and launder water is pumped with the spiral feed from the dredge to the separation plant. A slurry containing 17% solids is required for this arrangement. The water for wash and launder use first overflows a weir in the constant-density cone. It is further desanded in a baffle tank and then screened to remove suspended organic matter. The cleaned water produced has proved satisfactory for use

At its Cudgen South floating plant the company

has utilized the natural settling capacity of the dredge pond. Pond water, free of settled solids, and screened of organic matter, is used for wash and launder water. This arrangement has proved most satisfactory and has permitted the pumping of a slurry containing 25% solids from dredge to plant.

Titanium Alloy Manufacturing believes it should be possible to effect a considerable degree of concentration of beach sands by sizing, but experimental work using a D.S.M. screen suggests that the size range of beach sand is too narrow to enable a satisfactory rejection of coarse quartz to be made without loss of heavy mineral. This is because the D.S.M. screen relies more on chance presentation to the openings in the sieve-bend than on positive screening.

Iron Ore Reserve Exploration by Hole Deflection

An account of deflection diamond drilling at Wabana Mines, contributed by the staff, appears in the *Canadian Mining and Metallurgical Bulletin* for May. The Wabana iron ore mines, owned and operated by the Dominion Steel and Coal Corporation, Ltd., are on Bell Island in Conception Bay, on the east coast of Newfoundland. In 1958 the average daily production of haematite ore was close to 12,000 tons, almost all of which was concentrated in a heavy-media plant.

The haematite-rich beds, believed to be of primary shallow-water sedimentary origin, lie amidst strata known as the Bell Island and Wabana Groups of Lower Ordovician Age. The three mineable beds outcrop near the north-west shore of Bell Island and plunge under Conception Bay. They vary in thickness from a few inches to 40 ft. and are designated as the Lower, Middle, and Upper Beds for their respective locations in the sequence. Approximately 240 ft. and 50 ft. of intervening strata separate, respectively, the Lower Bed from the Middle Bed and the Middle Bed from the Upper Bed.

The mineable ore zones are not regular. They may consist of haematite with or without bands of iron-bearing or barren shale. In the case of the Lower Bed it is common to encounter two ore bands 8 ft. to 10 ft. in thickness separated by barren silty shale of from 3 ft. to 8 ft. in thickness. Dependent upon the grade of the haematite bands and the thickness of the shale parting-rock some sections of the Lower Bed attain an economically workable thickness of 35 ft. Occasionally the grade of the haematite bands comprising the Lower Bed and the thickness of the shale parting-rock are such that only one ore band of the total Lower Bed may be considered ore. This variation in grade and thickness may occur within a few hundred feet, requiring mining areas to be adjusted to include or exclude particular sections within relatively short distances.

Formerly entry had to be made in one of the beds before the others could be explored by diamond drilling. This was due to the low dip of the ore structure. It was, therefore, impossible to estimate ore reserves, or to determine the existence and location of lean zones beyond the limits of underground development. Exploration until 1952 was carried out on a limited scale by drifting and diamond drilling. The orebodies had been entered through four separate slopes, each slope serving a separate mining operation. Up to that time, also, total production did not exceed 1,680,000 tons in any one year and averaged less than 1,000,000 tons annually. At such a rate of extraction from a relatively large number of working faces exploration and development presented no great problem. Although extensive lean zones had been encountered, sufficient readily accessible reserves were available to sustain production at slope hoisting capacity and market demand. Diamond drilling, consisting of inter-bed drilling, exploratory drilling at fault locations, and "safety" holes drilled in advance of development drifts, totalled 10,000 ft. annually.

To meet the increasing demand for iron ore an expansion programme was initiated in 1950, and by 1953 the mine was equipped to handle a yearly production of 3,000,000 tons. Increased production demanded more rapid development and delineation of greater mineable ore reserves. This was necessary first to provide sufficient mining sections and working faces for the additional mining equipment and, secondly, to delimit sufficient developed reserves to support a large increase in annual production. The accelerated rate of advance into unexplored areas disclosed, as was expected, that mineable areas are interspersed with extensive lean zones of irregular shape necessitating quick development of new areas and consequent extension of transportation facilities.

The additional mining equipment introduced was essentially of the trackless type. Pre-requisites for the efficient use of this equipment are :—

(1) Areas of reasonable dimension free of extensive local faulting and of suitable mining height must be located and fully developed. Mining plans must be prepared in detail.

(2) Maximum concentration of units.

(3) Provision of adequate ore handling and service routes.

Where extensive local faulting exists, or in areas of limited dimension or mining height, it has been found advisable to use alternative mining methods and equipment. In a submarine deposit information on seam thickness and ore grade can be secured only through exploratory drifts driven at suitable intervals well in advance of present working faces. This is time-consuming and openings may prove to be in poor locations for effective employment.

Underground workings extend three miles offshore to the north and the distance between the eastern and western extremities is 17,000 ft. Thus one would anticipate that any exploration work must be carried on over widely scattered areas with consequent high costs. With this in mind it was decided to investigate the practicability of drilling diamond-drill holes over the ore beds from the periphery of the present workings so that they could be deflected to intersect the ore beds at suitable intervals.

The possibility of applying known controlled diamond-drilling techniques to explore the ore potential in advance of development faces was first considered in 1957. Technical management of the Joy Contract Drilling Division, which was then engaged in inter-bed exploration drilling, recommended a study of the problem. It was evident that

a programme of development of a suitable method would have to be undertaken. As a result it was decided that such a programme would be jointly carried out by the technical management of Joy's Contract Drilling Division and the operating management of Wabana Mines.

Wedges of various designs and the Thompson arc-cutter had been successfully employed in other properties to control or direct exploration diamond-drill holes. Most other previous applications have dealt with holes drilled at relatively steep downward inclinations. The gentle dip of Wabana haematite beds requires holes to be drilled at relatively low angles to minimize the length of hole and still achieve a satisfactory intersection of the beds without risking too severe a strain on the drilling equipment.

A drill location was selected in the Lower Bed ore on the high side of a 40-ft. down-throw fault. From this site it was possible to place the hole in the hanging-wall of the ore and parallel to the dip of the strata. The objective was to deflect the hole through the ore bed at a pre-determined distance and angle of intersection. The site was chosen in an area that would permit uninterrupted testing and easy servicing from the main transportation levels.

Three basic types of deflection devices were chosen for the experimental controlled deflection of diamond-drill holes :—

(1) Thompson retrievable wedge and accessories.
(2) Thompson arc-cutting assembly.
(3) Thompson weighted-down barrel.

The initial pilot hole was collared flat and driven to a depth of 1,126 ft., with conventional AX coring equipment. At this point the dip of the hole had steepened to *minus* 6°. The Thompson weighted-down barrel was employed for a distance of 25 ft., without attempting to ream the bottom of the hole. No deflection of the hole was noted and the Thompson retrievable wedge was set at 1,136 ft. Drilling past the wedge deflected the hole an additional *minus* 3°, but subsequent advance with the Thompson arc-cutter flattened the hole appreciably. The failure of a rod joint, believed to have been a result of excessive wandering of the hole, prompted the decision to abandon this deflection.

After a section of the same hole was cemented an attempt was made to set a Thompson retrievable wedge at a depth of 300 ft. in the pilot hole. As the hole had been enlarged by excessive wear by the rods in the soft shales it was necessary, finally, to set the wedge at a depth of 248 ft. Drilling past the wedge and subsequent use of the Thompson arc-cutter steepened the hole to *minus* 9° at a depth of 270 ft. Drilling beyond this point with the arc-cutter flattened the hole again and further wedging was attempted. Again, due to the enlarged hole, the wedge was improperly set. Subsequent advance continued to flatten the hole and forced abandonment of this deflection. Recovery of the wedges from the enlarged hole was impossible.

The next attempt to deflect a hole was to follow standard practices for upward deflection from a relatively steep down-dipping pilot hole. A pilot hole was drilled into the footwall at a dip of *minus* 23° with conventional AX coring equipment and a Thompson retrievable wedge was set at 318 ft. Efforts proved fruitless to deflect the hole up through the ore bed using the Thompson arc-cutter and the hole had to be abandoned.

The third experimental hole was collared flat and drilled to 184 ft. with conventional AX coring equipment. The Thompson weighted-down barrel was successfully employed from 184 ft. to 308 ft. and achieved a deflection of *minus* 16°, or an average deflection of *minus* 1° 7′ per 10 ft. of advance. Gradual arcing was achieved by advancing 5 ft. in slow feed, pulling back, reaming this 5 ft. length three times in slow feed, and then repeating the procedure for the next 5 ft. Acid-etch tests were taken at 10-ft. intervals. At 308 ft. the Thompson arc-cutter was used in an attempt to increase the average rate of deflection. The hole was continued to 345 ft., using the arc-cutter. Use of the arc-cutter resulted in excessive deflection and consequent failure of drill rods and couplings. Attempts to by-pass this steep portion of the hole failed when the wedges were lost in the enlarged hole. It was apparent at this stage that use of the arc-cutter made control of deflection too difficult.

The section of the hole constituting the first deflection was cemented and a new deflection was started and successfully completed with the Thompson weighted-down barrel. A total deflection of *minus* 36° was obtained in 170 ft. of advance, or an average deflection of *minus* 2° 7′ for each 10 ft. of advance.

Having determined a drilling method which would still require study to improve efficiency attention was given to obvious necessary modifications to some components to ensure better performance and durability. The more important refinements to date are as follows :—

(1) Hard surfacing the ends of the 10-ft. AX drill rods to prevent excessive wear during the arcing operation.

(2) Change in hardness of the drift joints to reduce the number of failures caused by strain during arcing.

(3) Use of resin on all the drill-rod couplings in the arc section of the hole to prevent backing-off due to vibration.

The original experimental drilling site had been so chosen as to provide ideal conditions and permit uninterrupted testing of methods and equipment. Modifications were necessary in order to use the equipment in restricted working spaces and in any given location underground.

The experimental down-dip techniques were varied to suit drilling parallel to the strike and to obtain an intersection without having the advantage of a down-throw fault as existed at the experimental drill station.

The arc drilling method was revised upon the completion of the first successful experimental deflection to obtain an average *minus* 2° deflection for each 10-ft. section. The 5-ft. drilling and reaming cycle with tests at 10-ft. intervals was abandoned in favour of a shorter drilling and reaming cycle with tests at 5-ft. intervals. Although this change decreased slightly the average rate of advance, closer study of the deflection of the hole reduced the possibility of any divergence becoming too great before corrective measures could be taken.

It was found that, once a hole had substantially exceeded the planned maximum deflection for a 10-ft. advance, it was not practicable to correct for this deflection and successfully continue the hole. Continued advance beyond an excessive deflection would only result in repeated rod and coupling failures, with the added risk of losing a hole.

Attempts were made to correct the hole by cementing it throughout the length of the excessive deflection and drilling a new hole through the cemented area. After a short period of drilling the cement in the old hole wore or chipped away to a degree that the down-barrel apparatus would enter the steeper hole and resist all attempts to by-pass into the flatter-dipping new hole.

After resorting to the "5-ft. advance, ream, and test" cycle excessive deflections were noted before the hole had completely diverged from the proposed line-of-hole. It was possible thereafter to adopt corrective measures without inviting the loss of the hole. To correct for excessive deflection noted in a 5-ft. advance the drift joints were removed from the rods and the down-barrel assembly replaced with a conventional 5-ft. AX core barrel and wedge bit. The equipment could then be advanced in slow feed through the last 5-ft. advance and the correct amount removed from the back of the hole. On continued advance a small ridge remained in the bottom of the corrected hole. This did not seriously affect successive entries by the down-barrel or testing barrel assemblies.

Trade Paragraphs

Ransomes and Rapier, Ltd., of Ipswich, have compiled an illustrated folder which gives full particulars of their 1520 mobile crane for loads up to 15 tons and boom lengths up to 80 ft.

Mageo, Ltd., of Lake Works, Portchester, Hants, issue a leaflet which briefly describes their range of products for feeding, conveying, and screening and includes magnetic separators, bin level control, and bin vibrators.

W. C. Holmes and Co., Ltd., of Turnbridge, Huddersfield, in a recent leaflet give details of an alternative bag filter for less arduous duties than the Retroflux design mentioned here in the May issue.

Hadfields, Ltd., of Sheffield, in a new leaflet describe Hecla 174—a special alloy steel which will withstand alternate heating and cooling without the occurrence of crazing usually associated with heat shock. Many applications are indicated.

Imperial Chemical Industries, Ltd., of Millbank, London, S.W. 1, have provided an illustration of a

"Terylene"-cotton conveyor-belt with special rubber covers compounded to resist sea air and water, running in a limestone quarry in the West of England. Made by **Barrow, Hepburn and Gale, Ltd.,** the belt is 950 ft. long, and was made endless on site. "Terylene" was chosen to provide a belt of extra strength, increased impact resistance, and flexibility to work under arduous operating conditions.

Telegraph Construction and Maintenance Co., Ltd., of Mercury House, Theobald's Road, London, W.C. 1, in a recent leaflet call attention to their Telcleats by means of which most types of circular section cables up to 2 in. diameter can be secured to a variety of surfaces.

Pollard Bearings, Ltd., of Ferrybridge, Knottingley, Yorks., in a new 32-page illustrated catalogue give particulars of their "Self-lube" ball-bearing pillow blocks and bearing units. After an introduction and technical description there are notes on selection, details of load ratings, and descriptions and dimensions of the various types, followed by mounting instructions and typical applications.

Metal Detection, Ltd., of Moseley Street, Birmingham, at the Instruments, Electronics, and Automation Exhibition held recently in London were showing their electronic metal detector for the automatic signalling of ferrous or non-ferrous metals on a conveyor line, as well as their type T.N. tramp iron detector suitable for both iron and manganese.

N.C.K.-Rapier, Ltd., of 32, Victoria Street, London, S.W. 1, in a recently-produced leaflet describe their 205 Skooper for stand-still loading of rock or granular material up to 350 tons per hour. The machine is crawler mounted, has a bucket capacity of $1\frac{7}{8}$ cu. yd. for rock, $2\frac{1}{2}$ cu. yd. for general purposes, and $2\frac{1}{2}$ cu. yd. for rehandling and is equipped with a 64-h.p. diesel engine at 1,675 r.p.m.

Joy-Sullivan, Ltd., of Cappielow, Greenock, have issued a field report on the Joy 12 BU Loader which traces the history of this machine with its rotary gathering arms sweeping the material on to a central chain conveyor. The experience obtained from early installations demonstrated the need for a British-built Joy loader suitable for colliery conditions here with their thin variable seams and close timbering.

Visco Engineering Co., Ltd., of Stafford Road, Croydon, have published a leaflet which gives particulars and illustrations of their rotary feed valves for feeding and discharging powder and other granular material to and from spiral conveyors, chutes, hoppers, mills, cyclones, etc. The valves

are made of cast iron, high-duty iron, stainless steel, or aluminium and in both standard or vacuum types. A chart shows the throughput in tons per hour and is accompanied by dimension diagrams of the various sizes available.

C. H. Johnson (Machinery), Ltd., of Adswood, Stockport, announce the introduction of their Mk 4 mud pump embodying many advances in design and giving a maximum output of 3,600 g.p.h. and heads up to 80 ft. A new type of gearbox mounting has been developed, whereby the gearbox is flange mounted to a steel plate member above the pump chamber instead of being foot mounted as previously. A new design of pump body has been developed with easy-clean anti-clog ball valves, the chamber of which is cast on to the pump body instead of being bolted on. The standard engine fitted is the Lister LD.1 air-cooled diesel, but alternatives are available. Electric drive can also be provided.

Associated Electrical Industries (Rugby), Ltd., of Rugby, state that four dual-purpose tower-mounted mine winders have been supplied for the N.C.B.'s Kellingley Colliery. Two of these, each driven through a co-axial reduction gearbox by a 1,100-h.p. a.c. motor, are in use in No. 1 tower at the colliery. These multi-rope friction winders are the first in Britain to be mounted in a tower and used as drum winders for sinking a shaft. Two other winders, twice as powerful, have been installed in No. 2 tower. These, too, will be used both for shaft sinking and for raising coal. Each of these winders will be driven through a twin-input gearbox by two motors of the same rating as those in No. 1 tower.

Glacier Metal Co., Ltd., of Alperton, Wembley, Middx., have published a 23-page designers handbook (No. 2) which gives some of the established applications for their DU dry bearings and their DQ dry bearing materials and DG and DL surface treatments. They point out that makers of machinery for mining and civil engineering works are giving increasing attention to the possibility of reducing man-hours and at the same time increasing life between overhauls by the use of the DU type of oil-less bearing. These are robust steel-backed bearings and are coated with a special mixture which is keyed firmly to the base and impregnated with P.T.F.E. so that they are truly oil-less and yet at the same time have a low friction coefficient and high load capacity.

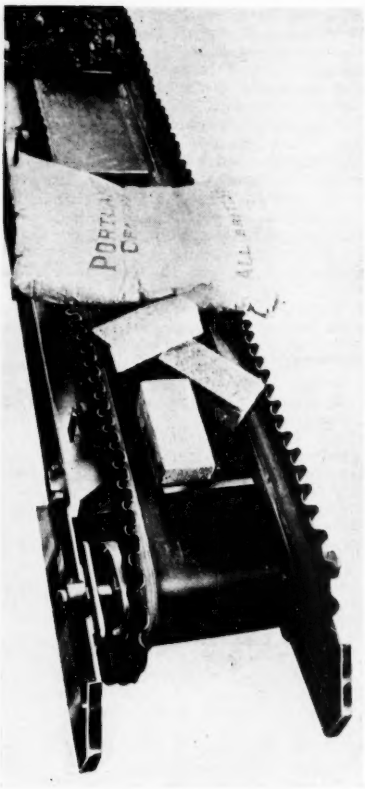
Dowty Mining Equipment, Ltd., of Ashchurch, Glos, state that the Dowty Roofmaster self-advancing system of roof control is now in operation in Zabzre colliery in Poland. It has been installed on a face 60 in. high and 240 yd. long in conjunction with a 125-h.p. shearer and an armoured conveyor. Installation commenced in late January and was completed in only 14 working shifts by 18 men, including two of the company's service engineers. Working conditions were reasonable with a soft floor, a hard grey shale roof, and very hard abrasive coal. The stables were supported by using Dowty "Duke" hydraulic props and link bars. Since the installation output has risen to an average of 23·5 tons per manshift with a maximum of 41·6 tons, giving an output of about 1,650 tons clean coal per day, compared with a previous output of 5·5 tons per manshift.

Cementation Group of Companies, of 20, Albert Embankment, London, S.E. 11, announce that a contract for the construction of a 1,200-ft. deep shaft has been awarded by the United States Atomic Energy Commission to their American subsidiary. The shaft will provide access to a drivage designed for the detonation of a nuclear device for the development of atomic energy for peaceful purposes. Known as "Project Gnome," the site is at a point 25 miles south-east of Carlsbad in the salt beds of New Mexico. Work will begin on the project shortly and is scheduled for completion by June, 1961. Another notice issued by the Group states that a contract has been awarded by the N.C.B. for the relining and "making safe" of the shafts of Thorne Colliery, Yorkshire, closed in 1957. Although work will commence almost immediately it will be approximately 2½ years before the shafts are re-opened.

Bakelite, Ltd., of 12–18, Grosvenor Gardens, London, S.W. 1, announce that they are now marketing a series of epoxide and polyester systems for cable jointing which have a number of technical and economic advantages over more conventional jointing materials. Several cable manufacturers have already approved the use of this series. Bakelite epoxide resins possess good adhesion to most surfaces, particularly to metal conductors, armouring, and most types of tape and when used in cable jointing compounds eliminate the need for cumbersome site heating equipment. Because of the inherent strength of cast epoxide resins simple moulds made from thermoplastic sheet, pulp, or similar materials are quite adequate and obviate the use of metal joint boxes. The controllable quick-setting characteristics of these resins also make possible a quicker jointing cycle. Full details are contained in Advance Information Sheet E.40 just published.

AEI-Birlec, Ltd., of Tyburn Road, Erdington, Birmingham, in a recent publication include details of a new range of refrigeration dryers for compressed-air applications. In some notes on it they state that while dryers of the adsorption type are capable of reducing dewpoints down to values of — 150° F. their operation may be uneconomic if only moderate dryness is required. To meet the needs of users requiring compressed air at dewpoints down only to freezing point a new range has been developed. Compared with adsorption drying there is a saving in capital cost as well as in operating, power consumption being generally halved. These new dryers, which are recommended for service where freezing conditions are rarely experienced, will be suitable for operation on the majority of compressed-air applications in Europe and particularly in the tropics. The refrigeration units are conventional in operation and drying takes place by lowering the temperature to condense entrained water vapour. After separating out the condensate the air is restored to room temperature. Dryers of ten capacities from ½ h.p. to 20 h.p. constitute the new range.

Numec, Ltd., of New Whittington, Chesterfield, issue some notes on their corrugated conveyor belting as illustrated here. The belting is manufactured exclusively by the **Dunlop Rubber Co., Ltd.,** in standard widths from 9 in. to 36 in. and with corrugated sides 2 in. and 3 in. high. It is constructed in rubber and canvas, the number of plies being governed by the load-carrying requirements of the specific application. The corrugated sides form tough walls on the straight without tension at the ends and they increase the load-carrying capacity of the conveyor by 25% in the case of the 2 in. side walls and by 50% for the 3 in. compared with conventional belting, it is claimed. The side walls



also allow an increase in the gradient of the conveyor, depending on the material being carried, and in some cases the increase may be by as much as 25%. The gradient can be further increased by the use of rubber flights moulded to the belt at right angles to the centre line of the conveyor. The belt has been designed to run on straight idler rollers so that troughing idlers are unnecessary and maintenance is thereby reduced. It can be used, however, on existing troughed rollers. The corrugated sides not only grip the load but also prevent belt sag between the supporting idlers. At a recent independent test it was reported that ½-in. small coal was elevated at an angle of 40° without difficulty.

RECENT PATENTS PUBLISHED

☛A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

17,236 of 1956 (834,568). KNAPSACK-GRIESHEIM A.-G. Process for the thermal production of magnesium.

31,952 of 1956 (833,767). TIMAX COPORATION. Continuous electrolytic production of titanium.

34,072 of 1956 (833,513). DEUTSCHE EDELSTAHLWERKE A.-G. Pulverulent raw materials are heated and brought into chemical reaction.

15,884 of 1957 (835,058). HOUILLIESES DU BASSIN DE LORRAINE. Cleaning iron-ore fines, especially for the manufacture of ferrous coke.

26,064 of 1958 (835,666). METALLGESELLSCHAFT A.-G. Sinterring apparatus.

41,012 of 1958 (834,197). NATIONAL DISTILLERS AND CHEMICAL CORPORATION. Continuous preparation of titanium and zirconium sub-chlorides.

NEW BOOKS, PAMPHLETS, ETC.

☛Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

Mine Ventilation. Edited by A. ROBERTS. Cloth, large octavo, 363 pages, illustrated. Price 70s. London : Cleaver-Hume Press, Ltd.

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